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The American Journal of Roentgenology

Edited by P. M. Hickey, M. D.
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THE AMERICAN
JOURNAL OF ROENTGENOLOGY

Editor, P. M. Hickey, M. D., Detroit
Associate Editor, F. C. Zapffe, M. D., Chicago

VOL. II NOVEMBER, 1914 No. 1

NEGATIVE DIAGNOSIS OF SURGICAL LESIONS OF THE STOMACH AND CAP

By LEWIS GREGORY COLE, M. D.
Professor of Roentgenology in Cornell University Medical College

The value of a positive diagnosis of cancer or ulcer of the stomach or cap is directly in proportion to the accuracy of the negative diagnosis. A diagnostic method which enables one to state with a reasonable degree of certainty that a patient has or has not a gastric cancer or ulcer, has or has not an ulcer of the cap, occupies a unique position. At the last annual meetings of both the Gastro-enterological Society and the Medical Section of the American Medical Association it was asserted repeatedly that the early diagnosis of gastric cancer is impossible. To this statement I take exception emphatically, referring you to numerous communications* which show the accuracy of the positive diagnosis of ulcer and cancer of the stomach and cap, and especially to a report on twenty-seven consecutive cases examined by serial Roentgenography and operated upon by Dr. Brewer.** Each of the twenty-seven cases presented sufficiently definite clinical symptoms of a lesion of the stomach or cap to justify surgical exploration. In eleven cases, or forty per cent of the number investigated, examination by serial Roentgenography resulted in a negative diagnosis of ulcer or cancer—or of any surgical lesion of the stomach or cap. Nor was a surgical lesion of the stomach or cap found at operation in any one of these cases. A negative diagnosis of gastric carcinoma and indurated ulcer of the stomach and cap has been made in five hundred and sixty-six cases out of the whole number of gastro-intestinal cases examined to date. Thirty-three of these cases presented sufficiently severe symptoms to justify surgical exploration; and it is upon the results in these thirty-three cases, operated upon by twenty-three different surgeons, that the present communication is based. The negative diagnosis of gastric cancer and ulcer of the stomach or cap was made in each case solely on the Roentgenographic findings, and in not a single instance was a lesion of the stomach or cap demonstrated by surgical exploration. In many cases a lesion at some other point in the gastro-intestinal tract was demonstrated Roentgenologically and proven by surgical procedure. As limited space prohibits a full consideration of each of the thirty-three cases, only eight characteristic cases will be described in detail and illustrated. Of the other twenty-five cases only the clinical diagnosis, Roentgenologic diagnosis and surgical findings will be given. In thirty-two out of the thirty-three cases the

*Arch. of the Roent. Ray, Dec., 1911, Apr., 1912, Oct., 1912. Journal of the Am. Med. Assn., Nov. 30, 1912. N. Y. Med. Jour., Feb. 14, 1914, Vol. xcic, No. 7, p. 305. Zeit. f. klin. Med., Berl., 79 . H. 5 u. 6, 1914. The Lancet, Lond., May 2, 1914, No. 4731, Vol. clxxxvi, p. 1230.

**Annals of Surgery (forthcoming issue).

surgical findings corresponded with the Roentgenographic findings in every essential detail, but in one case they differed to such an extent that it was impossible to explain the discrepancy. In most of the cases the incision was made directly over the pyloric end of the stomach, and in all cases the stomach and duodenum were examined through the laparotomy wound.

The technique by means of which our conclusions were reached has been fully described in previous communications.* An examination less complete than the one prescribed may suffice in a great majority of cases, but abbreviated methods lead to erroneous diagnoses in a sufficient number of cases to cast discredit on the Roentgen method and to rob it of the remarkable degree of accuracy which it can attain. Therefore I beg of you as Roentgenologists—do not apply the diagnostic principles described in this and previous communications to anything less than the complete serial examination.

Gastric cases may be divided into two classes with respect to a negative diagnosis of ulcer or carcinoma of the stomach or cap —(1) those which unquestionably present no unusual Roentgenographic findings, and (2) those presenting direct or indirect Roentgenographic evidence of a spasmodic lesion. The best illustrations of the first type of cases are found in symptomatically normal patients examined for experimental purposes. There is no difficulty in making a negative diagnosis of cancer or ulcer of the stomach or cap in cases of this kind, as the entire series of Roentgenograms shows the stomach and cap well distended and both surfaces of the pyloric sphincter clear-cut and well defined. Naturally such diagnoses are not proven by surgical procedure. Most cases however come under Class II. They have or have had more or less symptoms referable to the stomach and cap. Such symptoms, particularly "hunger-pain," are associated with spasmodic contractions of the stomach, pyloric sphincter or cap. These spasms present definite Roentgenographic findings, i. e., either direct evidence of the spasm itself or the results of continuous and repeated spasm, a condition already fully described in an article on the Relation of Lesions of the Small Intestine to Disorders of the Stomach and Cap.** They manifest an appearance simulating organic lesions from which they may and must be differentiated, lest the operative procedure indicated for a surgical lesion be performed at the site of a reflex spasm of unknown cause. The eight cases about to be described exemplify the marked discrepancies so often observed between the clinical and Roentgenographic findings.

*Amer. Jour. of the Med. Scien., July, 1914, Vol. cxlviii, No. 508, p. 92.

**Amer. Jour. of the Med. Scien., July, 1914, Vol. cxlviii, No. 508, p. 92.

FIG. 1—CASE XXVII.

For eighteen months this patient had suffered with pressure from gas. In the last six months she had complained of acute epigastric pain, perpetual belching and some regurgitation of bile. Attacks were almost always accompanied by prolonged vomiting, at one time for seventy-two hours. There was an entire loss of appetite and constant diarrhoea. Roentgenologically no gastric or duodenal lesion was found. In the Roentgenograms of the colon a loop of sigmoid was observed to lie in close proximity to an extremely prolapsed caecum and ascending

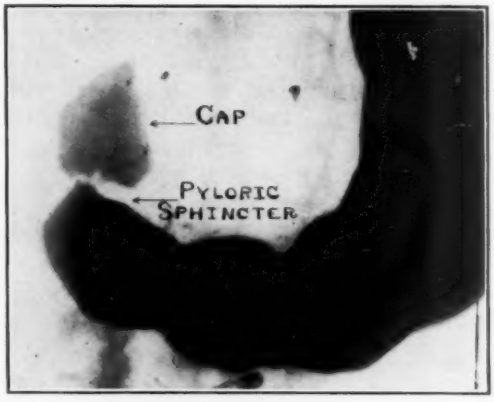


FIG. 1. Stomach Normal—Colonic Adhesions.

colon in a manner suggestive of adhesions at this point. At operation no lesion of the stomach or cap was found. The entire caecum and ascending colon were removed and the ileum transplanted into the transverse colon.

FIG. 2—CASE XVI.

Fig. II illustrates one of the most extreme spasmodic conditions that we have observed. A negative diagnosis of new growth of the stomach was made. The report reads: "The irregularly shaped cap, the hazy edges of the sphincter, and the lack of normal expansion and contraction of the pars pylorica indicate that there is some lesion involving this portion of the stomach. The six hour stasis would indicate an organic obstruction at the pylorus, but I believe the stasis is due to some functional disturbance of the stomach and cap rather than to an organic obstruction." The following is an extract from a letter sent at the same time to the surgeon who referred the case: "This case is typical of a group of about twenty cases in which there has been evidence of a definite lesion involving the pars pylorica and cap. I have not felt that I could advocate surgical interference in any of these cases, although I am exceedingly anxious to know what pathological condition causes these Roentgenologic findings. Therefore if the clinical history is sufficiently severe to indicate surgery, I should like if possible to be present at the operation." The surgical diagnosis was "no cancer or ulcer of the stomach or duodenum and no adhesions." A chronically diseased appendix was removed through a second incision.

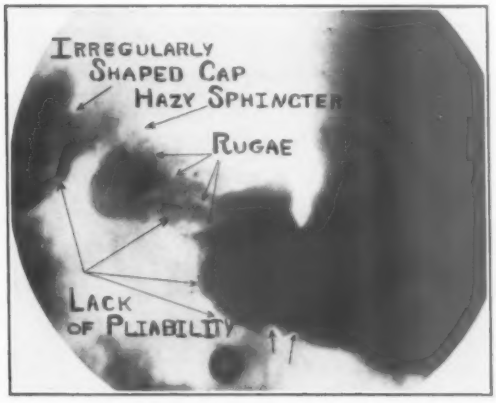


FIG. 2. Stomach Normal—Diseased Appendix.

FIG. 3—CASE III.

A negative diagnosis of new growth, ulcer of the stomach or cap, and adhesions was made in this case. It was even stated that "one is justified in making a negative diagnosis of any organic lesion of the stomach or cap." The clinical history however was sufficiently characteristic of an organic lesion of the stomach and cap to justify surgical procedure. No organic lesion was found at operation, after which the surgeon pronounced the case one of "neurasthenia."

FIG. 3. Stomach and Colon Normal.

FIG. 4—CASE XIII.

The patient gave a history of several attacks of abdominal pain and fever, followed by soreness in the lower abdomen. One of these attacks had been diagnosticated as acute appendicitis by a competent physician. Subsequently the patient had suffered from digestive distress with more or

less epigastric pain, gas and sour eructations after meals. The Roentgenograms

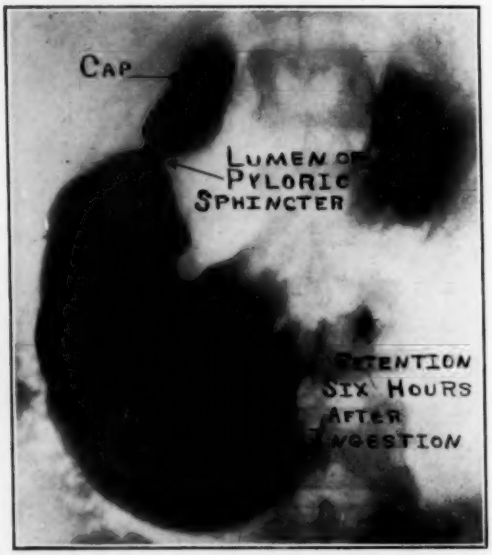


Fig. 4. Stomach Normal—Diseased Appendix.

showed no evidence of new growth, ulcer or adhesions of the stomach or cap. The only unusual finding was a prolonged gastric retention. At operation the stomach, duodenum and gall-bladder were found to be normal. A chronically diseased appendix was removed. The gastric retention observed Roentgenographically was functional.

Fig. 5—Case XIV.

One of the cases which showed a glaring inconsistency between the clinical history and Roentgenographic findings was referred to me with a definite history of duodenal ulcer. The clinical history was so characteristic that there seemed to be no doubt of the diagnosis, and the patient was sent to me for the purpose of increasing my number of duodenal ulcers. This was a hospital case, and I economized on the plates, making only about one-half the usual number of exposures. The patient was to be operated on the next day for duodenal ulcer. My diagnosis was "spasm of the cap, negative diagnosis of new growth or indurated ulcer of the stomach or cap." This negative report delayed the operation temporarily. The following day the symptoms localized in the right iliac fossa and an emergency operation for an appendix was performed in the middle of the night.

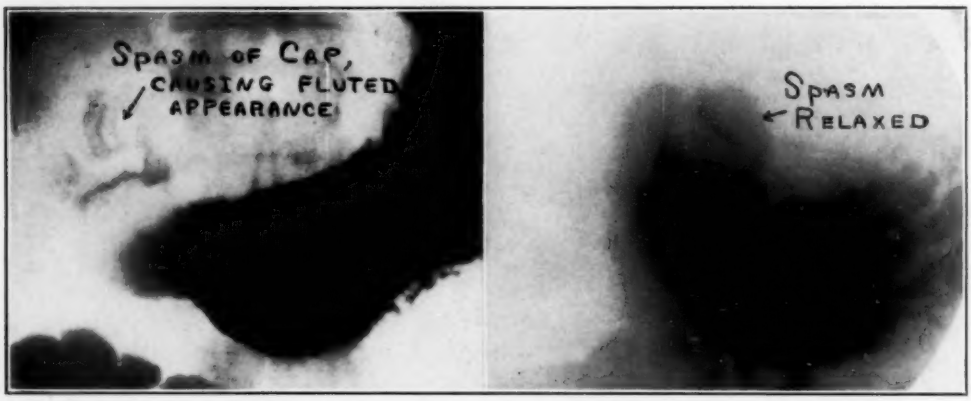


Fig. 5. Stomach Normal—Acute Appendicitis.

Fig. 6—Case XV.

This patient had been under observation in the hospital for seven weeks with a typical history of gastric ulcer, including even vomiting of blood, as we were informed later, although she appeared for Roentgenographic examination without giving a clinical his-

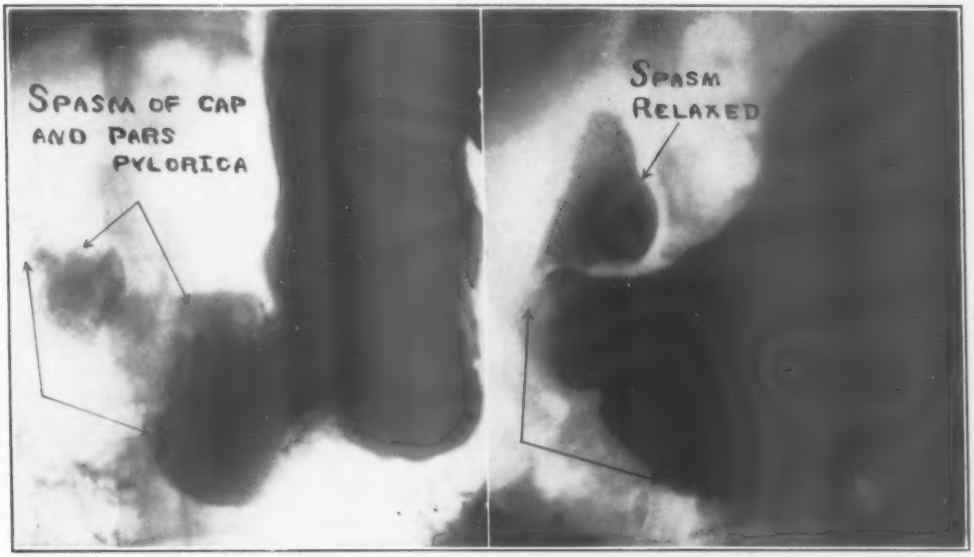


FIG. 6. Stomach Normal—Chronic Appendicitis.

tory. A Roentgenologic diagnosis of negative cancer or ulcer of the stomach or cap was made. An extreme functional derangement of the stomach was observed and the patient was advised to return for an examination of the colon and appendix. Subsequent examination showed a normal colon and bismuth retention in the appendix. We were then told that the clinical history was absolutely typical of gastric ulcer, and were offered an opportunity to hedge; but we "stood pat" on a negative diagnosis, and no surgical lesion of the stomach or cap could be demonstrated surgically. A thickened appendix filled with feces was removed.

FIG. 7—CASE XXVI.

The patient had been admitted to the hospital with a diagnosis of perforated gastric ulcer. His symptoms were acute epigastric pain and severe and protracted vomiting. The vomitus contained blood. Roentgenographically no evidence of new growth, indurated ulcer or adhesions of the stomach or duodenum was found. An acute angula-

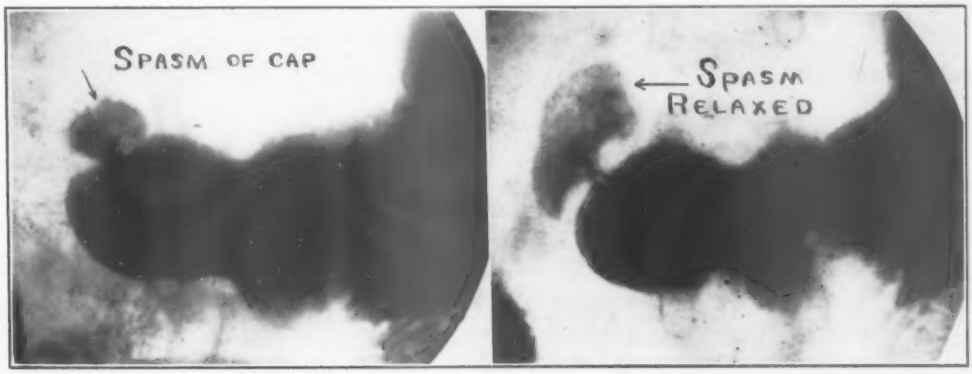


FIG. 7. Stomach Normal—Colonic Adhesions.

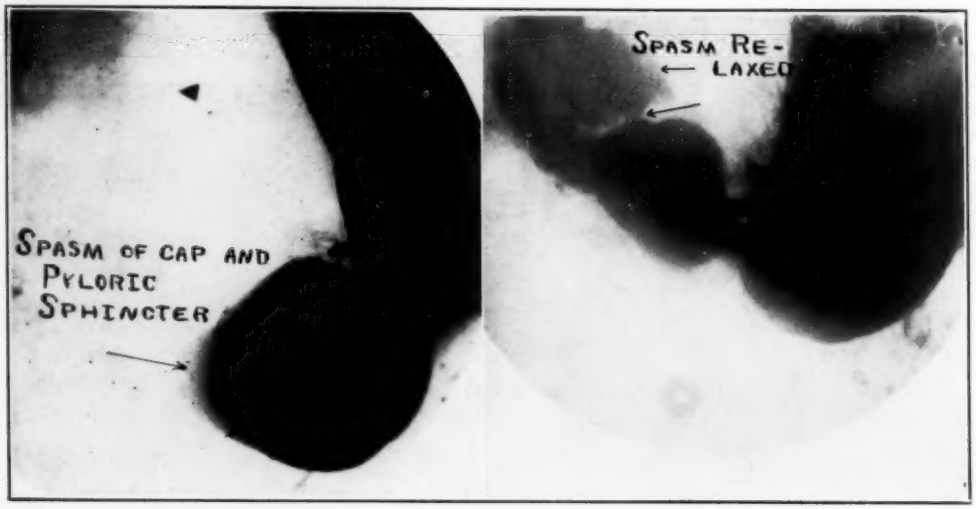


FIG. 8. Stomach Normal—Carcinoma of Colon.

tion in the first portion of the transverse colon was observed. Operation revealed a normal stomach, duodenum and gall-bladder. There was a band of adhesions on the ascending colon causing angulation.

FIG. 8—CASE XXVIII.

Eighteen months previous to the Roentgenographic examination the patient began to have dull pain after eating, sometimes in the epigastrium, at other times in the right or left iliac fossa, lasting from five to fifteen minutes with subsequent prolonged discomfort. There was a great deal of belching, soreness across the lower abdomen and through to the back, and a loss of twenty-five pounds in eighteen months. Roentgenologically the important finding was a marked pylorospasm which at certain stages of digestion completely occluded the pyloric opening. When the spasm relaxed it was evident that there was no organic lesion of the stomach or cap. As a carcinoma of the colon was found at operation, it was unfortunate that the colon was not examined Roentgenographically.

The remaining twenty-five out of our thirty-three cases will simply be enumerated and the diagnoses given in brief. Many of the patients presented such atypical symptoms that a definite clinical diagnosis had not been attempted. The following is a list of the whole series of thirty-three cases, the eight cases already considered in detail being marked with a star.

	Clinical Diagnosis	Roentgenologic Diagnosis	Surgical Findings
CASE I.	GASTRIC ULCER.	Stomach and Cap Normal.	Stomach and Cap Normal.
CASE II.	PERNICIOUS ANEMIA.	Stomach and Cap Normal.	(Post Mortem Findings.) Stomach and Cap Normal.
CASE III.*	GASTRIC ULCER OR CARCINOMA.	Stomach and Cap Normal.	Stomach and Cap Normal. Diagnosis, "Neurasthenia."

	Clinical Diagnosis	Roentgenologic Diagnosis	Surgical Findings
Case IV.	Gall-Bladder Infection.	Stomach and Cap Normal. Negative Diagnosis of Gall-bladder Infection.	Stomach, Cap and Gall-bladder Normal.
Case V.	Pyloric Obstruction.	No Organic Lesion of Stomach or Cap. Prolapse and Slight Dilatation of Stomach.	Stomach and Cap Normal. Slight Dilatation of Stomach.
Case VI.	Gastric Ulcer.	No Organic Lesion of Stomach or Cap. Hypertrophy Gastric Muscularis.	No Organic Lesion of Stomach or Cap. Hypertrophy Gastric Muscularis.
Case VII.	Tumor of Spleen.	Stomach and Spleen Normal. Kidney not Examined.	Stomach and Spleen Normal. Hypernephroma of Kidney.
Case VIII.	Duodenal Ulcer.	Stomach and Cap Normal. Gall-stones. Colon not Examined.	Stomach and Cap Normal. Gall-stones. Colon not Examined.
Case IX.	Gastric Ulcer.	Stomach and Cap Normal. Gall-stones.	Stomach and Cap Normal. Gall-stones.
Case X.*	Gastric Ulcer.	Stomach and Cap Normal.	Stomach and Cap Normal. Cholecystitis.
Case XI.	Duodenal Ulcer.	Stomach and Cap Normal. Adherent Appendix.	Stomach and Cap Normal. Adherent Appendix.
Case XII.	Duodenal Ulcer.	No Organic Lesion of Stomach or Cap. Spasm of Cap and Pyloric Sphincter. Colon not Examined.	Stomach and Cap Normal. Diseased Appendix.
Case XIII.*	Chronic Appendicitis, or Duodenal Ulcer.	Stomach and Cap Normal. Prolonged Gastric Retention.	Stomach and Cap Normal. Chronic Appendix.
Case XIV.*	Duodenal Ulcer.	No Organic Lesion of Stomach or Cap. Spasm of Cap.	Stomach and Cap Normal. Acute Appendicitis.
Case XV.*	Gastric Ulcer.	No Organic Lesion of Stomach, Cap or Colon. Spasm of Cap and Pars Pylorica. Retention in Appendix.	Stomach, Cap and Colon Normal. Diseased Appendix.

	Clinical Diagnosis	Roentgenologic Diagnosis	Surgical Findings
Case XVI.*	Duodenal Ulcer.	No Organic Lesion of Stomach or Cap. Spasmodic Lesion of Pars Pylorica and Cap.	No Lesion of Stomach, Cap or Gall-bladder. Diseased Appendix.
Case XVII.	Prolapsed Kidney. Reflex Gastric Symptoms.	No Organic Lesion of Stomach or Cap. Spasm of Cap and Pars Pylorica. Gastroptosis.	Stomach and Cap Normal. Adherent Appendix. Prolapsed Kidney.
Case XVIII.	Duodenal Ulcer.	No Organic Lesion of Stomach or Cap. Pylorospasm. Adhesions Involving Caecum and Ascending Colon. Insufficiency of Ileocaecal Valve.	Stomach and Cap Normal. Adherent Appendix.
Case XIX.	Duodenal Ulcer.	Stomach and Cap Normal. Colonic Adhesions.	Stomach and Cap Normal. Appendicular Adhesions.
Case XX.	Gastric or Duodenal Ulcer.	Stomach and Cap Normal. Colon not Examined.	Stomach and Cap Normal. Chronic Appendix.
Case XXI.	Unknown.	Stomach and Cap Normal. Adhesions at Hepatic Flexure. Retention in Appendix.	Stomach and Cap Normal. Adherent Appendix.
Case XXII.	Duodenal Ulcer or Gall-Bladder Infection.	Stomach and Cap Normal. Retention in Appendix.	Stomach and Cap Normal. Diseased Appendix.
Case XXIII.	Cholecystitis.	Lesion of Cap and Pyloric Sphincter. Cause not Determined. Examination Incomplete.	Stomach and Cap Normal. Chronic Appendix.
Case XXIV.	Unknown.	Stomach and Cap Normal. Gastroptosis.	Stomach and Cap Normal. Numerous Adhesions and Kinks of Colon. Atrophic Appendix.
Case XXV.	Duodenal Ulcer.	Stomach and Cap Normal. Adhesions of Caecum and Ascending Colon.	Stomach and Cap Normal. Jackson's Membrane, Involving Colon, Appendix and Duodenum.

	Clinical Diagnosis	Roentgenologic Diagnosis	Surgical Findings
Case XXVI.*	Perforated Gastric Ulcer.	No Organic Lesion of Stomach or Cap. Spasm of Cap. Adhesions Involving Ascending and Transverse Colon.	Stomach and Cap Normal. Band of Adhesions on Ascending Colon.
Case XXVII.*	Gastric or Duodenal Ulcer.	Stomach and Cap Normal. Sigmoid Adherent to Caecum and Ascending Colon.	Stomach and Cap Normal. Adhesions of Caecum and Ascending Colon.
Case XXVIII.*	Gastric Carcinoma.	No Organic Lesion of Stomach or Cap. Spasm of Pyloric Sphincter. Colon not Examined.	Stomach and Cap Normal. Carcinoma of Colon.
Case XXIX.	Colonic Stasis.	Stomach and Cap Normal. Constricted Caecum. Insufficiency Ileo-caecal Valve.	Stomach and Cap Normal. Ulceration Large Bowel. Insufficiency Ileo-caecal Valve.
Case XXX.	Colonic Stasis.	Stomach, Cap and Colon Normal. Colonic Stasis.	Stomach and Cap Normal. Entire Colon Removed.
Case XXXI.	Colonic Stasis.	Stomach and Cap Normal. Colonic Stasis.	No Lesion of Stomach or Cap. Typical Case of Colonic Stasis.
Case XXXII.		Stomach and Cap Normal. Pressure on Stomach from Without. Colon not Examined.	Stomach and Cap Normal. Extensive Adhesions Small and Large Intestines.
Case XXXIII.	Gastric Ulcer.	Stomach and Cap Normal. Chronic Obstruction Duodeno-jejunal Junction.	Stomach and Cap Normal. Obstruction Duodeno-jejunal Junction by Enlarged Retroperitoneal Glands.

In the early days of Roentgenology I well remember the efforts of some men to prove by sawing bones in a zig-zag direction that the negative diagnosis of a fracture of a long bone was of little or no value. Later there was a considerable stir when it was stated that one is justified in making a negative diagnosis of renal calculus. Renal colic and renal calculus were considered synonymous until case after case of renal

colic had been operated upon in spite of the negative Roentgenographic findings, and no calculus found. In both these groups of cases there are and always will be occasional errors, usually due to incomplete examination or careless interpretation of the Roentgenograms. But the remarkable accuracy with which these conditions can be recognized when present has justified one in stating with a reasonable degree of certainty that if they are not shown Roentgenographically, they are not present. Our thirty-three consecutive cases, which have been operated upon for lesions of the stomach or cap in spite of a negative Roentgenologic diagnosis, form a basis for concluding that the high degree of accuracy attained by the Roentgenologic diagnosis of fractures and renal calculi may also be claimed for the negative and positive diagnosis of surgical lesions of the stomach and cap.

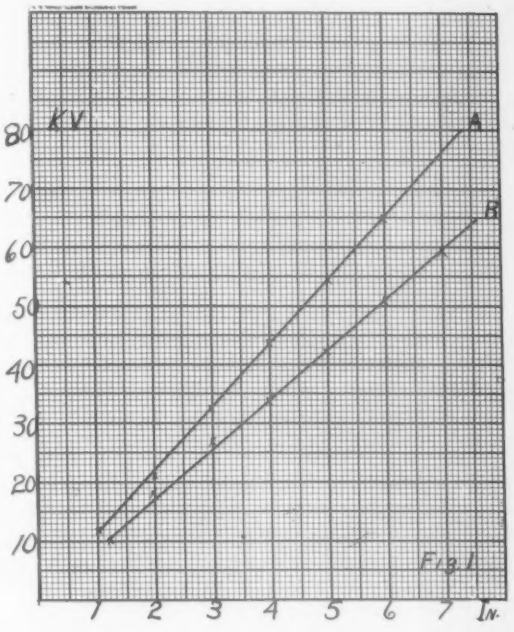
MEASUREMENTS WITH THE COOLIDGE TUBE

By J. S. SHEARER, Cornell University, Ithaca, N. Y.

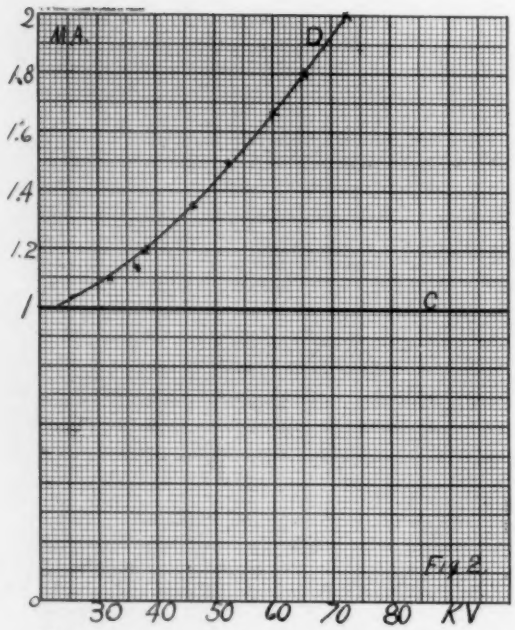
INTRODUCTION

The advent of a Roentgen ray tube in which current and voltage may be independently controlled marks a new era in the scientific study of this radiation and will permit a fuller realization of its usefulness in practice. During the last summer the writer has undertaken several problems and some of the results will appear in this and following reports.

The two factors which determine the quantity and the quality of the radiation from a given tube are the voltage consumed in the tube and the current passing through it. Increase of current at fixed voltage increases quantity of radiation only. But increase in voltage without change in current increases both quantity and penetration. It simplifies the interpretation of results if measurements are made at constant current and also at constant voltage. The common method of voltage measurement by the spark gap is not sufficiently reliable to give consistent results. An electrostatic voltmeter of the attracted disc oil immersion type with range from 10 to 150 kilo-volts was used in all the work. The approximate relation between its readings and an ordinary spark between rather blunt points is given in A, Fig. 1. The values are less than those found for breaking voltages in many cases since the voltmeter reads effective voltage for a sine wave and the spark gap measures "peak" voltage. It is found that fluoroscopic and photographic results can be duplicated well within the errors of measurement when such an instrument is used. It was quite impossible to duplicate readings when using spark gap settings. The reason was found when measurements of voltmeter reading and spark gap were made early in the day and again later after the tube had been run at high power for a series of experiments. The later results are shown B Fig. 1. The upper curve, A Fig. 1 is fairly easily duplicated when the air is normal but on ionization with poor ventilation a noticeable reduction in breaking voltage is found.



In order to get reliable results on current measurement it was found necessary to take great care to avoid leakage between the milliammeter and the tube. The effect of leakage on three feet of ¼ inch steel tape between tube and milliammeter is shown in Fig. 2. Two milliammeters were used; C, next the tube and D, in series with C joined by the steel tape. The current through C was kept constant and readings on D showed the tube current plus the leakage. At higher voltages this effect is even more marked. Of course this error is of most account when small currents are passed since the leakage is then a greater proportion of the entire current.

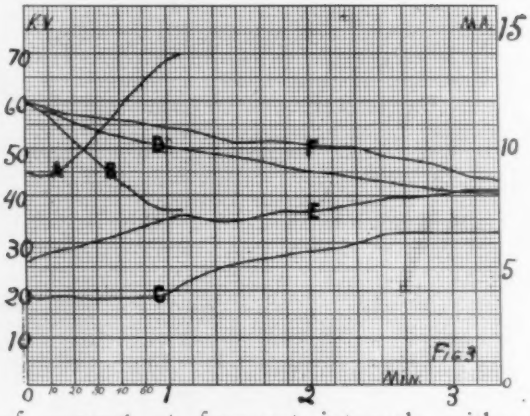


Three different tubes have been used in this work, two of ordinary size of focus and one of very sharp focus. The latter has been used in the study of screen brightness, the former where high power was used. All these tubes have been very easy to control and capable of running at absolutely uniform voltage and current. (Note. This of course refers to rectified A. C. current and voltage, not to any unfluctuating voltage.) The writer begs to thank Drs. Whitney and Coolidge of the General Electric Co. for their great courtesy and assistance in this work.

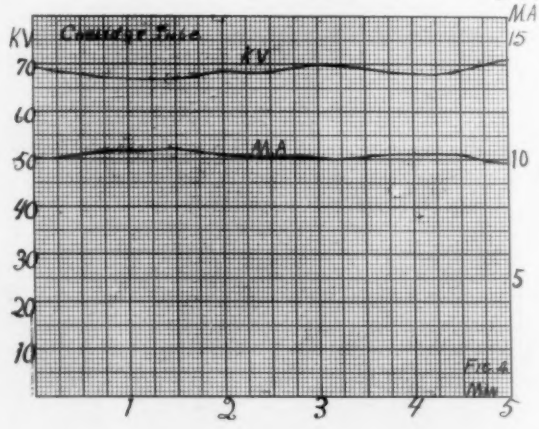
To Mr. Weeks and Mr. Swisher of the physical department staff, the author is indebted for assistance and many valuable suggestions, and for part of the expense of the work a grant from the Huntington fund has been available.

I
TUBE CHARACTERISTICS

The very great drop in penetration in an ordinary tube when operated above a very moderate power is not generally appreciated. Since the penetration is dependent only on the voltage consumed by the tube, the high tension voltmeter enables one to make penetration readings as well as those



of current at frequent intervals without changing current through the tube. Several runs were made with various ordinary tubes and with Coolidge tube No. 221 under various operating conditions. In Fig. 3 time is plotted along a horizontal axis, kilovolts at the left of the diagram and milliamperes at the right. Curve A is the current-time curve for a run of about one minute using a seasoned, tungsten target, ordinary tube. Starting at 9 M. A., B shows the drop in voltage. This means a drop in penetration during one minute from about 8 Benoist to a little above 5 Benoist. C is a current curve for the same tube after complete cooling, starting at 3.9 M. A. and 60 K. V. D is the corresponding voltage curve, a drop in 3 minutes from nearly 8 Benoist to 5. E and F are current and voltage curves for a Muller water cooled tube starting at about 5.2 M. A. Hardness change in 3 minutes from 8 to 5 Benoist. Fig. 4

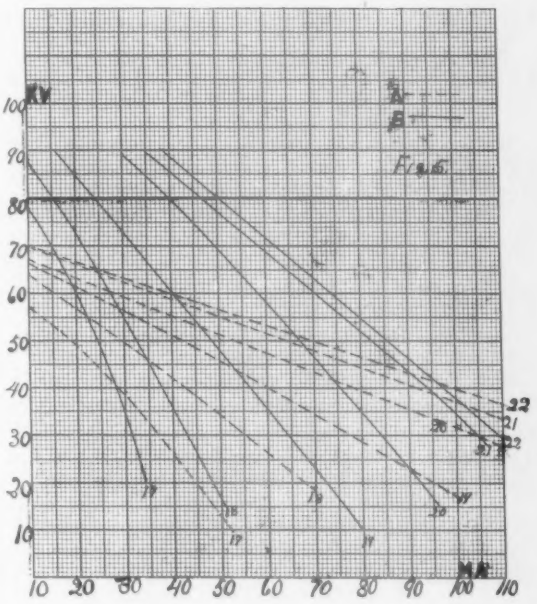


shows the corresponding run for Coolidge tube No. 221 starting at about 10 M. A. and 70 K. V. (Benoist 9). The battery which operated the filament was not quite steady, yet the maximum change when running at a current and voltage higher than shown in the case of the usual tube is only .3 of a unit Benoist. This shows the certainty of operation for treatment where continuity of quality is of the greatest importance. For convenience in comparison a curve giving voltmeter readings and Benoist penetration as read with a fluoroscopic screen are given in Fig. 16. This is an average curve for several observers and individual variations were quite small.

II
TRANSFORMER CHARACTERISTICS

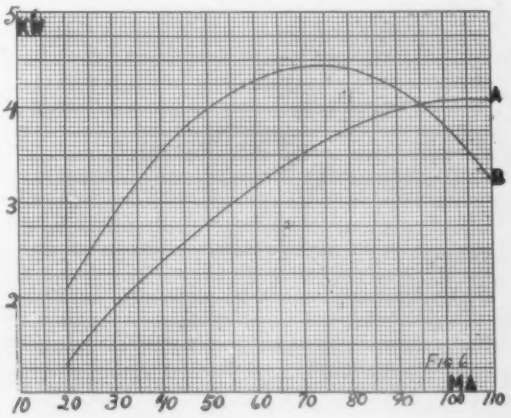
The ease of control and the certainty of reproduction of results with the transformer have resulted in its general introduction for radiographic work. With the new tube it is equally available and desirable for fluoroscopy and treatment. The question of the proper design for these three fields is thus of considerable interest. Some information in this connection may be secured by measurement of the actual performance of transformers with a tube as the load. The name of the maker is not given in the present case as the transformers were in the development stage. The results are therefore of interest *not* as *comparing transformers* now on the market, but as showing how they may actually behave under *working* conditions. It would be clearly impossible to carry out this work with the gas containing tube or with a spark gap measure of voltage. In fact tests at high power with the usual spark gap are meaningless in practice as the circuit conditions do not conform to those pertaining when operating a tube.

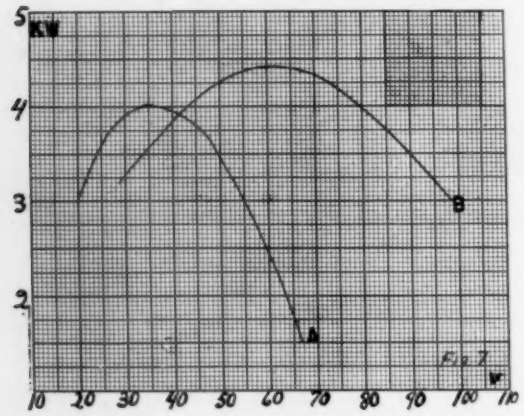
The measurements were made by taking simultaneous readings of current and voltage with various filament currents and on several rheostat buttons. The voltage-current lines are shown in Fig. 5, full lines



for one transformer and broken lines for the other. Coolidge tube No. 221 was used in this work and showed no bad effects from the rather severe treatment required when using full power. Both transformers were operated on a 220 volt line with heavy short leads to the power transformer. The effect of even slight line resistance is very marked at high current and would be much greater when using a 110 volt supply.

The difference between these transformers as regards the watts delivered to the tube is shown in Figs. 6 and 7 where maximum power at various currents and volt-





ages are plotted against current in 6 and against voltage in 7. While the *maximum* power which may be delivered to the tube is about 4 K. W. in one and 4.45 in the other, the range of voltage at which a fairly high power may be drawn is very much greater in B than in A. The maximum for A is at about 35 K. V. while for B it occurs at about 61 K. V. But little power can be delivered by A above 65 K. V. although *good sparks* can be drawn at 95 K. V. A can deliver very large currents at low voltage if such were desired, but this is not generally the case.

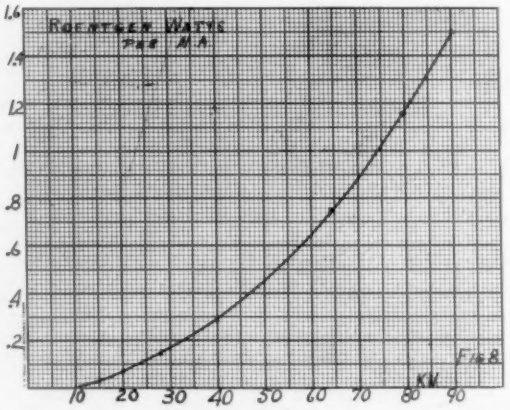
The work of Beatty shows that there is a relation between the relative amount of Roentgen energy produced in a tube, the atomic weight of the target and the electron velocity

$$\frac{\text{Roentgen Energy}}{\text{Cathode Ray Energy}} = 2.54 \times 10^{-4} AB^2$$

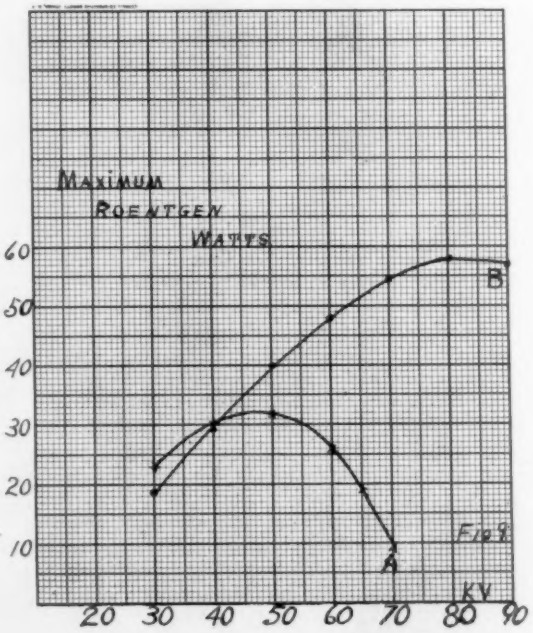
where A is the atomic weight of the target and B is the ratio of the cathode ray speed to the velocity of light. Since a tungsten target is used, $2.54 \times 10^{-4} \times A = .0467$.

While it may be doubted whether such a relation can be valid for extreme voltages and also whether effective voltage as measured can be used to give the *effective* cathode ray speed, yet there is no doubt that it is very approximately valid for comparisons up to the voltages used in practice.

It is clear that in this formula the fraction of the cathode energy transformed into Roentgen form increases with the voltage at which the cathode ray energy is delivered. Fig. 8 shows the Roentgen energy expressed in watts for one milliampere of current up to 90 K. V. If one multiplies the maximum current passed through the tube at any voltage by the conversion factor corresponding to that voltage we get an idea of the energy convertible into Roentgen energy by the transformer.



The curves of Fig. 9 show the results for the two transformers under discussion. There can be no doubt of the difference above 40 K. V. at which voltage they are



nearly identical. Thus when operating at 70 K. V., B will give 5½ times as much Roentgen radiation as will A. Experience in photographic work with these two transformers indicates that these conclusions are fairly correct. Thus for deep treatment A would be almost useless while B would do fairly good work. The writer hopes to test several machines in the near future to determine their characteristics as generators of Roentgen radiation.

III
BRIGHTNESS OF FLUOROSCOPIC SCREENS

The increased interest in fluoroscopic work and the demand for a substitute for the platino-barium cyanide screen made it seem well to publish the following brightness tests for five available screens.

It should be understood that brightness is not the only factor which must be considered in the selection of a screen. But certainly without illumination no screen is useful and this may well serve as a first test. The writer hopes to determine some other features in later work, especially the matters of lag and definition.

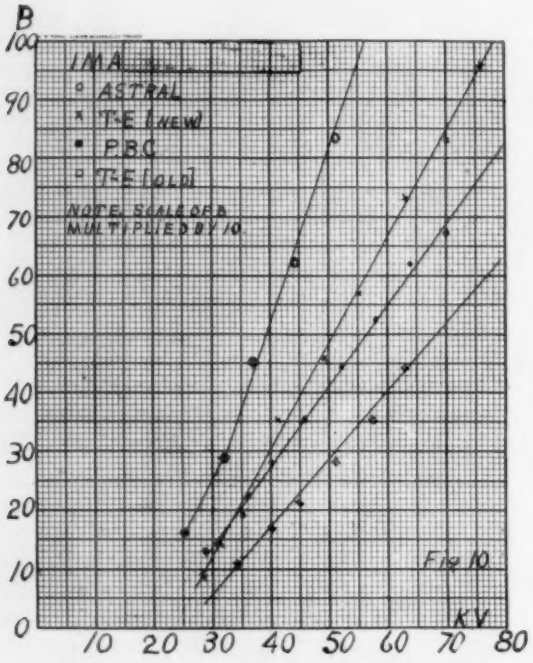
Five screens were secured for test, an Astral sold by the Kny-Scheerer Co., a Jackson platino-barium cyanide, a Patterson made by Mr. Carl Patterson of Towanda, and a T-E screen as formerly made by Dr. H. Threlkeld-Edwards. Dr. Threlkeld-Edwards kindly sent me a new screen he is developing and which was not on the market at the time of writing which will be designated as T-E (new). It is the policy of the writer not to publish results of measurements on incompletely developed apparatus but Dr. Threlkeld-Edwards kindly gave permission in this case.

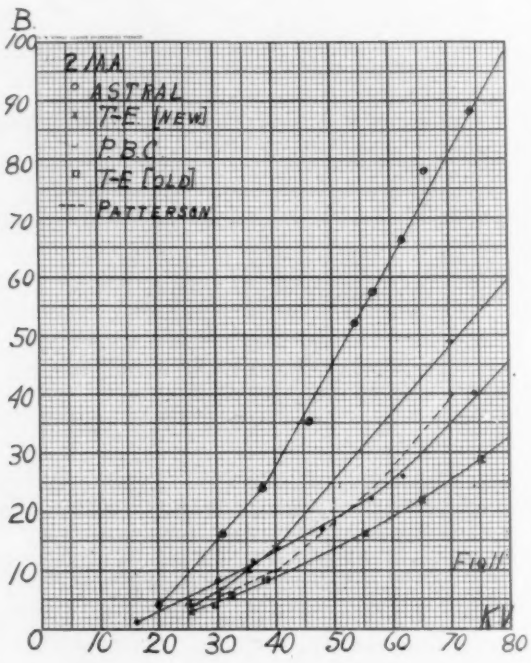
Brightness was measured by a photometer using a contrast field (Lummer-Brodhun) and a small tungsten lamp as a comparison standard. This lamp was operated by a storage battery and the current through it was measured in order to reproduce results when desired. Absorbing glass was used to secure an approximate color match, and by the use of standardized absorbing screens the brightness was reduced so that actual readings were all made at low brightness where slight lack of color match caused little difficulty.

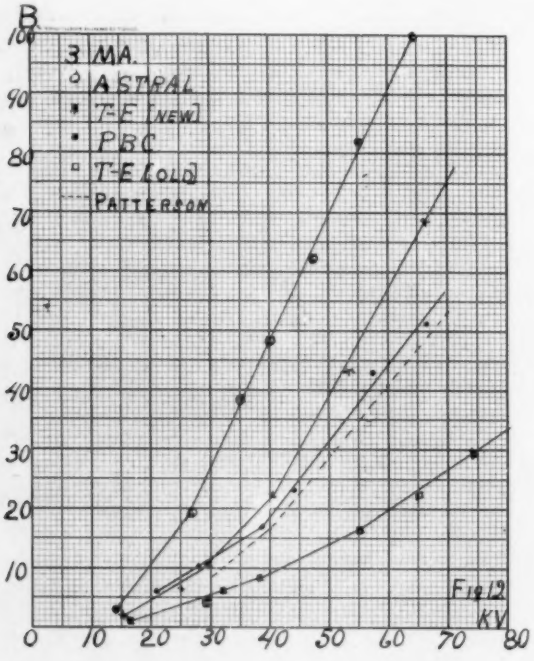
Preliminary tests showed that with the exception of the P-B-C screen results could be reproduced at will with an accuracy quite unexpected. With the P-B-C screen at low currents, such as are used in practice, no trouble was experienced for the short illuminations needed for setting. With the large currents used in a second series this effect is marked but is not observed in any other screen.

The curves at constant current may be derived from those at constant voltage and vice-versa. Several of these were drawn and then checked by measurements with very satisfactory results, Fig. 15. Voltage readings below 25 K. V. are not as reliable as those from that point up as the voltmeter scale is more crowded in that region but such low voltages are not generally used for practical work. After a certain value of the brightness peculiar to each screen is attained the lines are practically straight. Although the lag of the Astral screen is very pronounced this was found to have little or no effect on brightness readings made with rising currents or voltages. The color of both the Astral and the new T-E is nearer white than the P-B-C and less time is needed to fit the eye for the use of these screens on account of their greater brightness. The results in one case for very large currents are given, not because of their importance in fluoroscopy, but to show the great range over which the relation between brightness and current or voltage is very nearly linear when one of the control factors is kept constant.

The results are best shown by the curves in Figs. 10-15. The constant current curves are given from 1 to 5 M. A., the brightness unit is of course quite arbitrary. Fig. 15 shows the constant voltage (30 and 50 K. V.), brightness lines for two screens and indicates how the points taken from the


B
1 MA.
ASTRAL
T-E (NEW)
P.B.C.
T-E (OLD)
NOTE SCALE OF B MULTIPLIED BY 10.
KV
Fig 10


B.
2 MA.
ASTRAL
T-E (NEW)
P.B.C.
T-E (OLD)
PATTERSON
KV
Fig 11


B
3 MA.
ASTRAL
T-E (NEW)
P.B.C.
T-E (OLD)
PATTERSON
KV
Fig 12

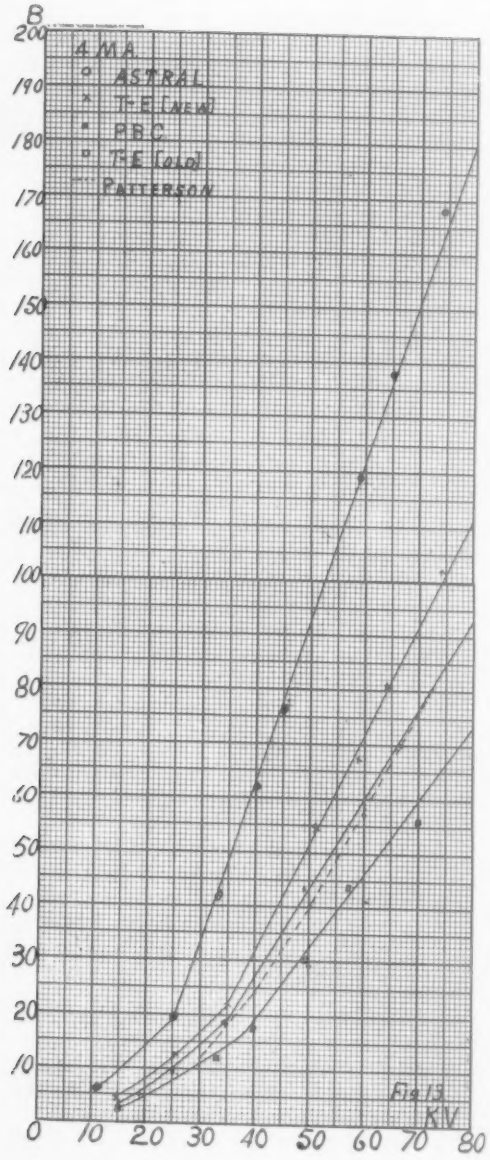

B
4 MA.
° ASTRAL
× T-E (NEW)
▪ P.R.C.
° T-E (OLD)
PATTERSON
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 10 20 30 40 50 60 70 80
KV

Fig. 13.

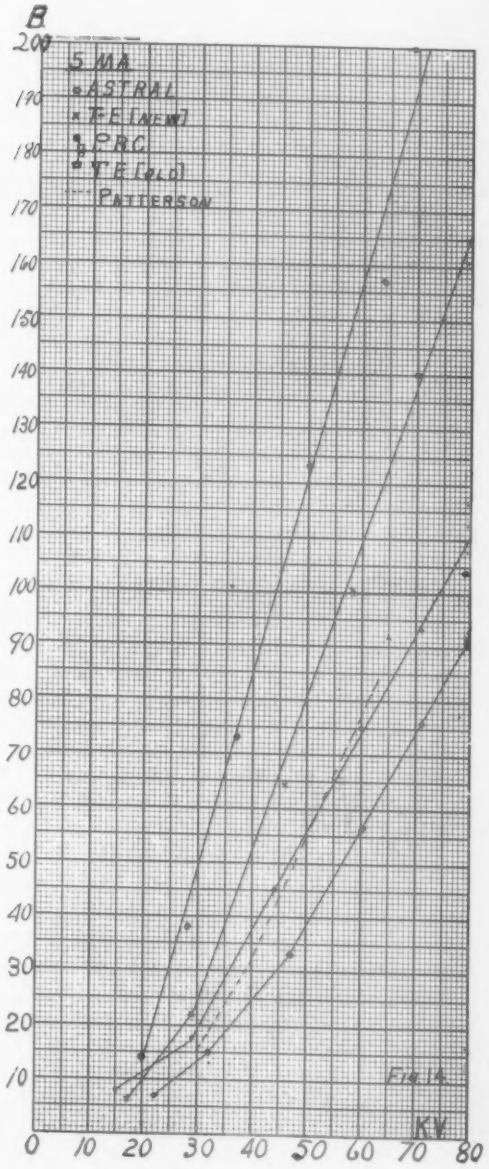

B
5 MA.
• ASTRAL
× T-E (NEW)
▪ P.R.C.
° T-E (OLD)
PATTERSON
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 10 20 30 40 50 60 70 80
KV

Fig. 14.

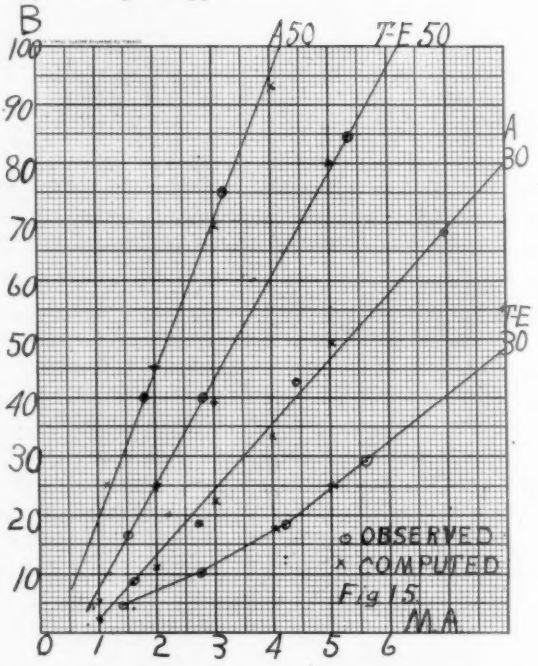
constant current lines check with those observed. If it should prove that visual acuity is as great with some of the brighter screens their brightness and permanence would make them very useful in fluoroscopic work. Fig. 16 shows the comparison of voltmeter readings and penetration on the Benoist scale.

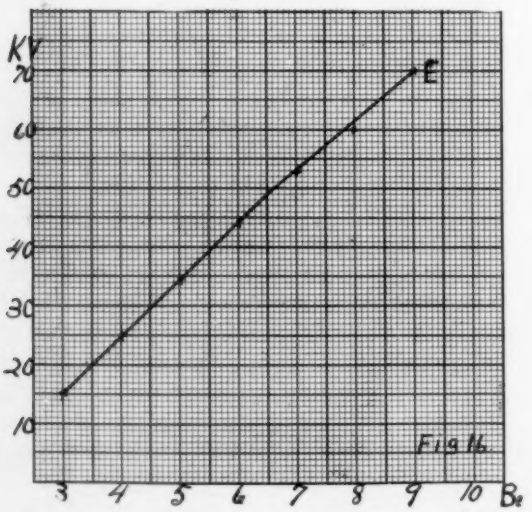
Fig. 17 shows observations at higher currents with the Astral screen. The 50 and 60 K. V. readings at high current were from 2000 to 3000 and the lines were nearly straight throughout.

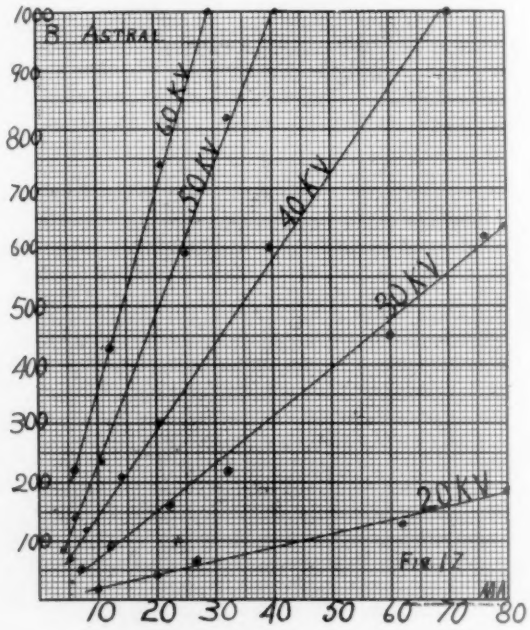
But few measurements were made with the Patterson screen as it was received after the work on the others was completed.

It appeared to have the same brightness as the P-B-C but different in color. It showed no change after high radiation.

The order as to brightness alone was always the same, the Astral the brightest, then the new T-E, the P-B-C and Patterson and the old T-E last.







THE CASE SYSTEM OF TEACHING ROENTGENOLOGY: A CONSIDERATION OF THE NECESSARY RELATIONSHIP OF SUCH TEACHING TO GENERAL MEDICAL EDUCATION

By DR. PERCY BROWN, Boston, Mass.

Mr. President, Ladies and Gentlemen:

A perusal of the published transactions of this Society, to say nothing of the general literature dealing with kindred matters, will reveal the occasional appearance of contributions relating to the pedagogy of Roentgenology. In 1906, V. J. Willey read upon the subject of the teaching of Roentgenology in medical colleges and the paper stimulated a discussion by many who at that time were more or less directly connected with educational institutions. Each participant in this discussion described, in part, his method of teaching, but no doubt departed from that meeting convinced that the teaching of Roentgenology should be given more and better attention. It is believed that this impetus was by no means the least of the late Doctor Willey's fruitful contributions.

During the succeeding eight years we have seen the birth of a mensurable recognition of Roentgenology by the representative medical schools, and, by some of them at least, a reputable status accorded its teachers. This development has been commensurate with the hopes of those of us who early despaired of any academic recognition, much less support, of our work. Especially satisfying to one who has at heart the welfare of this adolescent science has been the fact of the ultimate embracement of its pedagogics in their curricula by the more conservative of the medical schools. For this, it is believed that this Society has itself to thank, by virtue of its adherence to the ground which originally it took, not only in the early days of hysterical hyperenthusiasm, but in the even more dangerous reactionary period which followed inevitably. As an authoritative body, it cannot allow itself an instant of self-laudation, for there is much to do, if Roentgenology is to hold the pedagogic status which it even now enjoys, not to mention the advancement which must yet be made. The writer cannot quench his feeling that the teaching of Roentgenology, in many schools, especially to undergraduates, is as yet in an evolutionary state, and therefore anomalous and indeterminate as to its position in a curricular classification. The reasons for this are, among others, perhaps these:

(1) A lack of more than casual interest on the part of the undergraduate, which consequently discourages the teacher, or

(2) Naturally increased stimulation to teach arising from real interest on the part of graduates, therefore giving to Roentgenology an assumptive post-graduate flavor, or

(3) Feeble stimulation to teach caused by but mere nominal recognition of his office, or by the relegation of it to a position of adjunctcy, on the part of the school employing him.

Such causes as these, at least, seem so simple that they call for no great amount of analysis, and they represent conditions that are amenable to adjustment, but which can be regulated only by a process of pedagogic organization clearly mapped out.

The scope of this paper necessitates the consideration of Roentgenological teaching from every angle, and therefore it proposes to offer, first, a method by which this instruction shall be made more attractive to the undergraduate at a time when his mental formative period is most active. Second, there are herein offered suggestions intended, not thus to belittle the importance of this knowledge to the graduate of productive age, but to make *early* graduate interest the

more keen by incorporating Roentgenology in the mass of *elective* material which is open, as at Harvard, to fourth-year men. The spirit of this communication will convey also, it is hoped, the impression that, while but few are born teachers, the earnest Roentgenologist, if he *purposes* to teach, need have no uncertainty as to his position in medical education. From what has been but suggested as yet, it will be seen also that our real problem lies in the matter of undergraduate teaching, so that early seed may be sown for a harvest of post-graduate enthusiasm without placing another load upon the already fully-burdened undergraduate.

It is almost inevitable that the first tentative suggestions as to systematic teaching will be met with the query: As a curricular branch, is Roentgenology to be considered a clinical subject or a laboratory subject? It seems that such a question is answered automatically when one stops to consider the development of medical education. Is there really a line of demarcation between a laboratory subject so-called, and a clinical one, considering each in its strict sense; or, to put the question in another form, is there a branch of medical education today which is not both clinical and experimental? The subject of bacteriology was at one time taught chiefly within the confines of the laboratory, yet *clinical* bacteriology now is one of the pillars upon which stands the structure of preventive tropical medicine. Again, as students we were wont to consider mental disease as best studied in the wards, but today, what modern hospital for the insane but possesses its laboratory for psychopathic research? Roentgenology, likewise, is at once an Art and a Science—as much an Art as the art of the bedside practitioner of former days, and as great a Science as the science of the modern research-laboratory investigator. There can be no argument that the teaching of Roentgenology cannot properly be classified on the erroneous ground that it is of itself indeterminate.

The technics of Roentgenology have long been taught in the laboratory by those whose experience has qualified them as teachers. Willey, in his paper, and the discussors of his paper, outlined methods employed in laboratory teaching and suggested others, but at the time he made the statement which in these days seems almost prophetic: "If a majority of the plates studied are those of patients *seen in the clinics* . . . fresh in the mind of the student, so much the better." In discussion, Hickey made the remark which now has become so pertinent: "I favor the use of the lantern in teaching students the application of the Roentgen ray, preparing lantern-slides of as many negatives as possible, throwing them on the screen and *giving the clinical history of the case* . . ." These utterances of many years ago are interestingly significant.

Even graduate teaching has been to a degree indefinite through uncertainties arising from the very nomenclature which was created circumstantially in matters Roentgenologic. It is in a way regrettable that the Roentgen "laboratory" should ever have been so named. This noun, without an adjective, creates a wrong impression. A clinic it is and clinical it should be called, primarily for students—for the purpose of demonstrating to those who seek to learn. To what other laboratories—laboratories correctly named—is the patient, as a living problem, brought for investigation?

If the advanced undergraduate as well as the graduate seeking *clinical* instruction can be made to feel that Roentgenology is essentially a clinical subject, taught by a clinician, although it has, as has any other teachable subject, its experimental side in its laboratories of investigation—not in its clinics, he will desire to be taught, and it remains for the instructor to determine *how* he shall be taught, which is, essentially, the matter in hand.

At this point, however, the question may arise in argument: admitting that Roentgenology, in practice, may be considered a clinical subject having, like others, its experimental side, how can it be presented pedagogically as a clinical subject from mere plates, presented as stained pathological specimens might be presented? To offer

such a point in argument is but to confess to blind adherence to the Greek derivative, **Κλινικός.** The clinical atmosphere is not today confined to the bedside, although its nebulous nucleus may originate therefrom. The Roentgen plate is but a portion of a mass of clinical data which is obtained in many ways through intelligent use of the five special senses, and which is offered in evidence for the student carefully to weigh and to discuss. Thereon rests the central thought of this communication, which herewith suggests the following forms of application of Roentgenology to medical pedagogics:

(1) Primarily for undergraduates of the first and second years, as supplementary to prescribed instruction in anatomy, physiology, and pathology.

(2) Primarily for undergraduates of the third and fourth years, as supplementary to prescribed instruction in clinical medicine and clinical surgery.

(3) Clinical Roentgenology as a fourth-year elective.

(4) A course in clinical and laboratory Roentgenology primarily for graduates.

(5) A course in Roentgen therapeutics primarily for graduates.

This list is not so formidable as it may be thought to be at first glance. In the first and second years Roentgenology is made but supplementary to the principal courses of those years. Later, it is offered as a fourth-year elective and, after the degree is obtained, in the form of three courses of variant natures.

The success of undergraduate Roentgenological teaching as a supplement to the regularly prescribed courses of the first two years, has been proven. During the last years of the anatomical professorship, at Harvard University, of the late Thomas Dwight, the writer was given by him an opportunity to present the Roentgenological anatomy of the osseous system by means of stereoscopic demonstration. The method worked to a charm. The instructor was surprised at the proportion of men who at once saw and appreciated the stereoscopic image, and the students in turn were impressed by what was to them a revelation. This course occupied one hour a week for a portion of the first half-year, and no student was heard to complain of being over-burdened. To the writer, the experience gave an inkling of what might be done in similar manner with other courses permitting of such supplementation, as physiology, and especially pathology. This teaching will utilize the non-clinical resources of Roentgenology, and as such should be made plainly descriptive by means of stereoscopic records, lantern-slides, fluorescent screen or even the Roentgen-cinematograph, in so far as its development or the resources of the department shall permit. The degree of conception of the morphology of the recordable viscera, for example, which these students acquire, will be a source of wonderment to him who may still retain the memory of the inflated and dried stomach, proudly exhibited in class by his anatomical instructor, which possessed the form, more or less, of a miniature Zeppelin "dirigible."

Such instruction, as above outlined, even to men in earliest medical years, becomes a pleasure. The constant demonstration of what the men know to be living anatomy holds their attention completely. In the supplementary course above described, they were allowed to discuss what they had seen and to ask for further explanation. This plan could be amplified by the addition of an occasional quiz or conference. The form of examination in the Roentgenology of these prescribed subjects is a matter of option, but the plan of adding one question dealing with this subject to the paper of the prescribed general course, seems satisfactory.

There are here offered specimen examination papers applicable to various courses. Each contains several questions merely as exemplary of the one or two which might be added to the regular paper of the course. Those of anatomy and pathology only are

here presented as such examples. The remaining specimen will be considered hereinafter.

* * * * *

If, then, Roentgenology is to be included in the gamut of clinical subjects with which modern medical teaching deals, it is obvious that it cannot be taught by the same methods as would be applicable to students who are not ready for clinical subjects. It must be taught either by the didactic lecture and recitation system in conjunction with the same methods applied to clinical medicine or clinical surgery, or it must share with other clinical subjects the plans of improved teaching methods which have been devised for them.

Such an improved method has taken the form of the "case" system of teaching, as applied to medicine, which was first suggested by Prof. W. B. Cannon in 1900, at a time in his career when he could best appreciate, under the old methods, the growing hunger of the student for systematic teaching.

The very interesting natural history of the case-system applied to general medicine is now well known. A remark or two only concerning it is needed here. As Cannon says, it is but another application of the inductive method of teaching—compelling the student to call up the resources of his own mind and to match them with those of his fellows in poignant discussion. The method had its first brilliant results in the teaching at the Harvard Law School, and in the years following Cannon's suggestion we have seen its inestimable advantages in medical teaching. It has done away with the objections to the didactic lecture and recitation systems, and, at the same time, retains their advantages.

The original method employed, in this system of case-teaching thus suggested, is to give the student a printed slip containing the history of the medical or surgical case under discussion, together with such of the subjective symptoms and objective signs as are deemed needful to promote and to nourish such a discussion. Also is added any especial information obtained in the case such as that from an examination of the blood, the urine, the gastric contents and so on. The students argue these points in the presence of the instructor and, under his guidance and stimulation, supporting or invalidating each other's opinions and theories. Further details are unnecessary. The method is familiar to all medical educators.

The writer was a member of the first group of students who enjoyed the benefit of this form of personal teaching which was dignified by being, in point of fact, a consultation. Impressed by the breadth of the development of Roentgenology and convinced of its established function in clinical teaching, the writer herewith strongly urges the use of the case-method to that end. When one considers the completeness and the vividness of the Roentgenologist's data, he will realize how admirably the case-method will apply in teaching from these data. As a practical point, it may be said that instead of the printed history and general clinical information, the group of students can be shown a Roentgen record either by means of lantern slide or by illumination. Or, the printed history can be retained and distributed, to be read before the plate or slide is shown. The students then discuss the plate data with the instructor; they weigh the various points in differential diagnosis and attempt to arrive at the most rational answer by a process of exclusion. They compare the appearances with other physical signs and with the subjective data contained in the printed description. As a matter of fact, the case-system in Roentgenology is even more valuable because it brings to the student's mind an impression which can be obtained only by visual evidence. To say, for instance, in a printed case-description, that the apex-beat is so many centimeters more than normal outside the left nipple-line, cannot convey to the students the impression it does convey when he can *see* that the apex-beat *must* be in this position; he is then ready to discuss the

question as to *why* it is thus abnormally placed.

If the case-method is employed in clinical Roentgenological teaching, not only will it make attractive a course which heretofore may have had an impersonal bearing, but also, as a supplement to clinical medicine or clinical surgery, it will add new zest to the instruction in these subjects. The good points of the lecture or recitation-system can be equally well utilized by Roentgenology, and quizzes, as above mentioned, interspersed in such a course, will only add to its attractiveness. A quiz or conference is welcomed by the student when he feels that he has an individual position to take or an individual opinion to offer, and he will challenge with keenness any diagnostic opinions which are at variance with his own.

While a student's aptitude can be noted by the intelligent interest he takes in these discussions and his scholarship, in a measure, judged thereby, the question of tests or examinations can also be happily dealt with by a plan such as this.

One more practical suggestion is offered on this point. The benches or tables contained in the room wherein the examination is held can be equipped with small openings in their tops a certain distance apart and each having its dimensions in accordance with the standardized dimensions of a set of small transparencies which are to be used for examination purposes. Beneath these openings can be placed an incandescent lamp in an enclosed box and the aperture itself can be covered by ground glass, or similar material. Thus the examination-room will have, it will be seen, a set of individual illuminators so small as not to be intrusive and capable of arrangement so that the student need not sit in close proximity to his neighbor. At the time of the distribution of the formal paper in clinical Roentgenology, each student is handed one or two reduced transparencies of some clinical situation especially adapted for teaching purposes, the manifestations in which are to be based upon the instruction received during the year. On one or more of the questions in the printed examination paper there shall be given to the student other clinical data necessary to a proper conception of the case. He then is to apply his reasoning toward diagnostic ends and to discuss it in his blue book exactly as if he were, in common with his fellow-students, looking at some record as the basis of a conference discussion. This plan makes the examination systematically equal in value with the system of teaching during the school-year.

In closing, it is merely necessary to speak of the desirability of presenting a course in clinical and laboratory Roentgenology primarily for graduates, as stated under Heading 4 above. Such a course is, naturally, but partly clinical. In the clinical portion of this course, the case-method can be utilized and in the remaining portion, the good points of the lecture system, as well as demonstrations, can be employed. The writer herewith presents to you a specimen examination paper in such a course. Question No. 5 has a direct bearing upon the case-method of teaching. Other questions reflect a form of teaching more didactic, and deal with points based upon previous technical demonstration. It will be seen also that certain of these questions have to do with the teaching of Roentgen Therapeutics. Roentgen Therapeutics can, of course, be embraced in a general Roentgenological course, as under Heading 4, or it can be dealt with in a course by itself in accordance with Heading 5. Finally, the writer's plea is that Roentgenology, in the state of its advancement today, be made, as to its teaching, of a nature less impersonal, less formal and less cold. What better plan can attain this end than that suggested above? The student must be taught, when he looks at the complex of data we offer him, that this complexity, after all, is but relative and that the seemingly unnegotiable knots will unravel themselves if he will but ponder, if he will but think; for, as a translation of the old Dutch couplet has it,

"What use can light or lenses be
If young owls look and will not see?"

SPECIMEN EXAMINATION PAPERS

Roentgenological Anatomy

(Specimen examination paper. These questions are typical of one or two which may be included as a part of the examination in prescribed general anatomy for first or second-year students.)

1. State the general normal age at which the epiphyseal line at the lower end of the radius may be said to be closed.
2. How many centers of ossification does the upper end of the humerus present? Observed roentgenographically, in what order do they appear?
3. Describe in brief the shape of the stomach-shadow at the age of five.
4. What are the longitudinal and transverse *mean* dimensions of the adult heart-shadow?
5. Describe briefly the roentgenographic appearance of the jejunal walls.
6. Sketch roughly in outline the lateral aspect of the spinous processes of the seven cervical vertebrae, as seen roentgenographically.

Roentgenological Pathology

(Specimen examination paper. These questions are typical of one or two which may be included as a part of the examination in prescribed pathology for second-year students.)

1. What is meant by the osseous atrophy of disuse, and how may it be generally recognized in the roentgenogram?
2. Describe the general appearance of calcified lymph-nodes. Where may such nodes best be observed?
3. What form of cardiac pathology would be suggested by a circumscribed increase in the normal shadow representing the left base?
4. Specific endarteritis: state briefly its more important roentgenographic manifestations.
5. State briefly what pathological influences tend to change the usual conformity of the first portion of the duodenum.
6. Describe the usual roentgenographic manifestations of osseous proliferation.

Roentgenology

(Specimen examination paper in a course embracing general roentgenology, which may be given as a fourth year elective or primarily for graduates.)

1. Describe briefly the various practical applications of stereoscopy and discuss the merits of each method.
2. What is meant by the erythema dose? Describe as briefly as possible the Sabouraud technique.
3. What is meant by the term "Pyelography"? What information can be gained by this procedure?
4. In an observation of the fluoroscopic image of an enlarged thoracic aortic arch what appearances would lead you to entertain or to dismiss the question of the existence of aneurysm?
5. A patient is presented to you with the history of a blow received in the right loin by a falling beam from a building in process of construction. He presents the symptoms of traumatic shock, accompanied by intermittent hematuria. You find by roentgenogram a discrete shadow lying between the pelvis of the right kindey and the fourth lumbar vertebra. Two years before the patient was known to have passed some small urinary calculi. Differential diagnosis?
6. Discuss roentgenologically the questions of chronic tuberculous nephritis and "surgical kidney."
7. What are the roentgenographic manifestations of supraorbital prolongations of the frontal sinuses?
8. In a case of prolonged and persistent intermittent trigeminal neuralgia, what regions for investigation are suggested to the roentgenologist?
9. Discuss briefly the question of filters and describe specifically the Pfahler filter. How does this filter act in preventing superficial dermatitis?
10. State briefly three possible causes of gastric hyperperistalsis, as observed both by screen and by serial exposure.
11. Describe in detail the Lange method of mastoid examination, stating with what determinate point this method deals.

THE EARLY DIAGNOSIS OF PULMONARY TUBERCULOSIS

By FRANK S. BISSELL, M. D., Minneapolis
Instructor in Roentgenology, University of Minnesota,
And ERNEST T. F. RICHARDS, M. D., St. Paul
Instructor in Medicine, University of Minnesota.

The day of dependence upon physical signs for the early diagnosis of pulmonary tuberculosis is past. A new conception of symptomatology, Roentgen methods, and immuno-chemical reactions now offer the means for the recognition of this disease at a stage hitherto unsuspected.

Pulmonary tuberculosis in its earlier stages may masquerade under a most bizarre, indefinite and apparently innocent symptomatology, and since undertaking this study, we have come to view the diagnosis of "neurasthenia" with even greater suspicion than hitherto. Easily induced fatigue, vague pains, decreased mental and physical efficiency, gastric disturbances, vaso-motor phenomena and other symptoms suggestive of a low-grade intoxication can with surprising frequency be brought down to a rational diagnostic basis. The necessity of going behind the scenes in cases of this type is an urgent one, and the lesson must be hammered home, that, in the presence of such symptoms, tuberculosis must be ruled out before we accept such diagnostic cloaks as neurasthenia, psychasthenia and asthenia universalis congenita. Repeated emphasis is necessary to persuade the practitioner of medicine not to wait for cough, fever, sweats and other evidences of an advanced process before suspecting the disease, but to demand that his patients be Roentgenized long before these develop. In the light of our present knowledge, a negative diagnosis in any suspicious case is not justifiable until a Roentgen examination has proven negative to tuberculosis.

The present communication is based upon (a) two hundred and nineteen cases studied and Roentgenized at the University Hospital during the past three years; and (b) the consideration of replies to a questionaire recently mailed to the members of this Society.

The cases can be conveniently grouped into three series, viz:

1. Those presenting only an indefinite train of symptoms, as outlined above, suggestive of a low-grade intoxication.

2. Those presenting pulmonary signs or symptoms but which were not in themselves distinctive of tuberculosis.

3. Those offering distinct clinical evidence of tuberculosis and Roentgenized to determine the extent of the disease.

SERIES NO. 1

Total number of cases	88
Showing characteristic Roentgen signs of tuberculosis	62
Subjected to subcutaneous tuberculin test	37
Positive to tuberculin	36
Negative to tuberculin	1
Confirmed by final diagnosis	61
Showing no characteristic Roentgen signs	26
Subjected to subcutaneous tuberculin	9
Positive to tuberculin	0
Negative to tuberculin	9
Confirmed by final diagnosis	26

SERIES NO. 2

Total number of cases	96
Showing Roentgen signs of tuberculosis	78
Subjected to subcutaneous tuberculin	14
Positive to tuberculin	14
Negative to tuberculin	0
Finally diagnosed pulmonary tuberculosis	78
Characteristic Roentgen signs absent	18
Subjected to subcutaneous tuberculin	2
Positive to tuberculin	0
Negative to tuberculin	2
Finally diagnosed not pulmonary tuberculosis	18

SERIES No. 3

Total number of cases..... 35
Showing characteristic Roentgen signs..... 35

Diagnosis before Roentgen Examination.	Roentgen Diagnosis.	Diagnosis after Roentgen Examination.
Chronic pulmonary tuberculosis 2	Extensive fibrosis of both lungs 2	Chronic pulmonary tuberculosis 2
Incipient tuberculosis 19	Incipient tuberculosis 12	Incipient tuberculosis 12
	Advanced tuberculosis 7	Advanced tuberculosis 7
Infiltration of one apex.....10	Involvement of both apices.... 6	Pulmonary tuberculosis 8
	One apex but both lungs.... 3	Advanced tuberculosis 2
	One lung including apex... 1	
Advanced pulmonary tuberculosis 4	Consolidation, fibrosis and cavitation 4	Advanced tuberculosis 4

ANALYSIS OF CASES

The marked conformity of the subcutaneous tuberculin reaction and the presence of the more typical Roentgen signs is one of the striking features of this study. This must prove of infinite value to the Roentgenologist in his effort to win the acceptance by the profession at large of this method of diagnosis. Until general acceptance prevails, and it has been conclusively settled that through the agency of the X-rays alone we can determine not only the presence of tuberculous lesions but their degree of activity as well, we must rely upon tuberculin, or some other immunochemical agent, for immediate confirmation of our diagnoses.

Tuberculin, as a diagnostic agent, has been frequently assailed and often condemned, but it continues to retain the support of most of the prominent workers in this field. It also rests upon scientific logic. Of many explanations for the phenomenon that of Wolff-Eisner is the most widely accepted. This is based upon the reaction of certain antagonistic forces to the tubercle bacilli lodged in the tissues of the body. The varied functions of these forces are to attack and destroy the bacilli, and to neutralize the poisons developed in the process of that destruction. The first of these functions falls upon a class of substances, or bodies or cells called amboceptors or lysins. In the performance of their function they give rise to an intensely powerful poison, which is partially neutralized by a class of substances called antibodies. The lysins or amboceptors deal not only with tubercle bacilli themselves but with their derivative tuberculin. "Tuberculin is non-toxic to healthy animals, but when introduced into the body of a tuberculous animal, it is seized upon by the lysin, and the secondary substance thereby produced acts as a powerful poison. It is the lysinized tuberculin which, acting as a poison at the site of injection, produces a local reaction; in the blood stream produces general reaction, manifested by rise of temperature and constitutional symptoms; and on the tuberculous centers, causing irritation and increased vascularity, produces the focal reaction. The lysinized tuberculin, however, may be entirely neutralized by the antibodies and then no reaction of any kind takes place."

Despite the valid claims of tuberculin for recognition, its place is primarily that of a corroborative measure, because, at best, it only points to an active lesion at some unknown point in the body, and because it requires most careful observation and interpretation, preferably in a hospital bed. Many of the patients of the type we are considering, are, of course, not sick enough to consent to extended investigation.

In our classification we have used the term "characteristic Roentgen signs" to differentiate those appearances upon which we have come to rely chiefly for a diagnosis of early tuberculosis, from those which are less typical and may be observed in other lung affections. It thus becomes necessary to define these signs and to found them, if possible, on a firm pathological hypothesis.

The tubercle bacillus produces an endogenous toxin, which, though mild, is sufficient to act as a stimulus to the cells in situ. The effect of this stimulation is a characteristic response on the part of the endothelial leucocytes which accumulate around the tubercle bacillus and attempt to ingest it. A typical tubercle is the result. Fusion of the endothelial leucocytes forms giant cells,

and later, if the lesion is progressive, a central necrosis, tending to spread toward the periphery, occurs. This more common result is believed to occur when the bacilli are few, and the reaction of the tissue cells to their presence a gradual, rather than a rapid one. The bacilli are, as a rule, gradually distributed along the lymph vessels or the epithelial-lined spaces through the agency of the endothelial leucocyte. If, however, there is an absence of any degree of immunity, as in the young child, there is a more rapid diffusion of the organisms through either the blood or lymphatic system, and we see the well-known dissemination of miliary tubercles.

The marked tendency for the tuberculous lesion to heal is well recognized. The process may undergo repair in one area while destruction proceeds in another.

Gohn's belief that the *primary* focus of pulmonary tuberculosis is always in the lung itself, but rarely if ever at the apex, and that the glandular changes at the hilus are *secondary*, is now very generally shared by European clinicians. The idea conforms remarkably with the conclusions reached quite independently of Gohn's pathological studies by many Roentgenologists in America and with our own observations.

We have long believed that the earliest and only characteristic Roentgen signs of pulmonary tuberculosis are minute islets of increased density which tend to group themselves in a typical manner in certain elected localities in the lung. If these minute punctate areas are the earliest expression of pulmonary tuberculosis, their histologic explanation must essentially lie in the characteristic endothelial cell reaction to the bacillus tuberculosis. We have considerable justification, therefore, for describing these groups of islets of increased density, observed in the stereoscopic Roentgenogram, as tubercles in the broadest sense of the term. If we employ this pathological expression, however, we must be extremely careful to limit its application to certain very typical areas of increased density, since we frequently observe grosser changes of somewhat similar character which may be the result of other infections.

"Tubercles," then, from a Roentgenological standpoint, are very soft and faint, often requiring the experienced eye to detect them, and their first points of election appear to be (a) in the first and second interspaces near the median triangle, and (b) toward the periphery of the lung near the angle of the scapula. If, as frequently happens in an active lesion, there is an accompanying exudate of fibrin, serum and lymphocytes, the area surrounding these tubercles is cloudy in comparison with other areas in the lung field. As the process goes on to repair, with hyperplasia of fibroblasts and the formation of connective tissue, the field in which the tubercles lie becomes much broken in appearance, marked by interweaving striae of increased density. This "network" may remain after the lesion has healed and all evidence of active tuberculosis has disappeared, so that we do not consider its presence alone of diagnostic value. We must remember, too, that fibrosis and thickenings of the bronchial arborizations may be the result of other irritants than those of the bacillus tuberculosis, and as we have encountered this network so frequently in other lung infections we have come to consider it of little value except as a corroborative sign.

In this study all the stereoscopic Roentgenograms of patients Roentgenized during the past three years have been reviewed and classified into those showing typical "tubercles" as described above, and those in which these characteristic changes were absent. The filed case records have also been reviewed to learn the final diagnosis made by the clinical staff. It is illuminating to note that practically every case in which "tubercles" were observed was finally diagnosed pulmonary tuberculosis, and that the negative cases were quite as uniformly confirmed. Doubtless some of these final diagnoses were acceptances of the Roentgen

diagnosis without confirmation, but they at least indicate that no other cause was found for the patient's symptoms, and since the Roentgen method was on trial during this period, it may safely be assumed that every effort was made to either confirm or refute the Roentgen diagnosis.

In series No. 1 several of the cases in which "tubercles" were not found, show punctate areas of increased density apparently distributed along the bronchial tree. Roentgenograms of the teeth in some of these revealed root abscesses from which streptococci were isolated. While the appearance of the lung fields is similar to that seen in so-called peribronchial phthisis, the spots are more dense and massive than those usually seen in tuberculosis, and the characteristic "grouping" of early phthisis is not in evidence. Cases of this type offer the greatest difficulty and should be held indeterminate pending the discovery of the etiologic factor. Not infrequently one meets with an analogous condition in children in whom tuberculosis has been excluded by the Von Pirquet test.

In series No. 2 there were nine cases in whom the only symptoms were those of bronchial asthma, and seven of these show characteristic Roentgen signs of tuberculosis. There is a record of tuberculin test in only three of these, but all were positive.

Syphilitic involvement of the lung has been believed a rare condition, but it is probably more common than has been suspected. The Roentgen signs are usually distinct though somewhat similar in character to those of tuberculosis.

It is the occurrence of numerous cases of this character (unproven either positively or negatively) which renders temporarily invalid any claim that our Roentgen signs are pathognomonic of tuberculosis. However, before such a claim can be disqualified, it must be shown that tuberculosis is definitely absent in a large number of cases presenting these signs.

Our third series is chiefly of interest in that it seems to confirm the observations of many other observers, that the Roentgenogram usually shows more extensive involvement than is suspected when physical signs are present, and that extensive involvement of one lung alone is a rare occurrence.

CONSIDERATION OF QUESTIONAIRE

With the thought in mind that many men have been making independent Roentgen studies of pulmonary tuberculosis, it seemed that it might prove a profitable undertaking to address a questionaire to the members of this Society to obtain, if possible, an aggregate volume of evidence, which might tend more conclusively to place the subject on a scientific foundation. In reply many simply denied sufficient experience to speak with authority, but twenty replies are very complete and replete with interesting material. Fourteen of these believe in the pathognomonicity of certain Roentgen signs of pulmonary tuberculosis in the earliest stages, while only three do not and three are doubtful. Some of those who reply in the affirmative seem to rely upon later signs than those described in this paper. Among such signs are "deficient excursion of the diaphragm and failure of lung to light up on deep inspiration." One reply covers the question very thoroughly: "The pathognomonic Roentgen signs which I recognize are fibrosis, infiltration, consolidation, calcification, abscess formation and adhesions." "Pretubercular disease" is a new diagnosis which allows many loop-holes for the wary.

In our opinion too much reliance is placed upon the disturbed linear markings, which some men style "the Dunham development." A careful reading of Dr. Dunham's writings shows that he considers this only part of a general clinical picture, and he rarely mentions it without other signs. Yet, it is apparent that many men rely entirely upon this broken field for their early diagnosis, and this must inevitably lead to many errors. There is little profit in making the Roentgen diagnosis of a tuberculous lesion, unless

there is some evidence that it is a *recent* process. When the process is recent the general character and distribution described in this paper are always present.

The opinion is quite universally expressed that the stereoscopic method is infinitely superior to the fluoroscopic for early diagnosis, although Carman, of Rochester, says, "If I had to limit myself to either the Roentgenogram or the screen, I should choose the screen, but prefer both to either alone."

Much difference of opinion exists as to the possibility of determining the *activity* of a given lesion from the X-ray examination alone. If the lesion is in a clouded area, suggesting a state of hyperaemia, there is certainly reason in assuming that it is active. An active or recent lesion, too, is much more prone to appear in continuity with a chain leading toward the hilus of the lung. The suggestion is made by several observers that repeated examinations made at intervals may show progression and thus indicate activity. Since, however, it is our contention that a tuberculous lesion may be active (i. e. symptom-producing) without necessarily being progressive, a negative observation could not be accepted. It is in this all-important determination of activity in the early lesion that the combined efforts of internist and Roentgenologist are most severely taxed, and in which assiduous attention to early symptomatology with the correct employment of tuberculin is of the greatest value.

CONCLUSIONS

Pulmonary tuberculosis should be suspected in all cases presenting obscure symptoms suggesting a low-grade intoxication.

A careful history of the case is quite as important to the Roentgenologist as to the internist.

It must be constantly borne in mind that a negative Roentgen diagnosis is as valuable and perhaps more conclusive than a positive.

The profession must be taught not to depend upon physical signs for either a positive or a negative diagnosis of early pulmonary tuberculosis.

The Roentgen method offers the only possible means of diagnosis in these cases, and the only means of immediate corroboration of the Roentgen diagnosis at present available, is the subcutaneous tuberculin test.

While, for many reasons, it would be a desirable consummation to eliminate the tuberculin test and rely entirely upon the objective signs offered by the X-rays, this is not practicable until we have very definite proof that such signs are pathognomonic.

An effort should be made by this society through the individual work of its members, to determine the pathognomonic Roentgen signs of this disease and to give them a scientific nomenclature.

The present series of cases offers some evidence that there are pathognomonic Roentgen signs of this disease, but this evidence must be supported by a great many more controlled cases.

All Roentgen signs of disease should be founded upon a sound pathological hypothesis.

Hilus tuberculosis is usually secondary to a focus in the lung. The primary focus may occupy any area in the lung field, but is particularly prone to elect certain points which have been described in this paper.

The fact must be emphasized that the last word in tuberculosis has not been spoken and that investigations must continue until a diagnosis can always be made with absolute assurance.

The series of cases presented with this communication, especially emphasize the necessity for the correlation of all clinical data for the diagnosis of these obscure cases.

CASE REPORT

By W. A. QUIMBY, M. D., Wheeling, W. Va.

This child was delivered by Drs. J. L. Hitchcock and J. Hunter of Rayland, Ohio, Nov. 15, 1914. This was called to the attention of the local profession by R. H. Wilson, Physician and Surgeon, Martins Ferry, Ohio.

This is the first born to Mr. and Mrs. F. D., both Italian. As far as can be ascertained, there are no twins on either side of the family. The mother is aged 22 years, weight 115 lbs., height 5 ft. 2 in. The father is a well built man of 23 years of age, coal miner.

This subject was a full term infant giving a head presentation, being turned later to a breech and delivered in such manner. The heads were delivered side by side, causing only a moderate laceration. No knowledge of this monstrosity was acquired by way of examination previous to delivery.

This child was of male sex of the average size, except its chest and shoulders were unusually broad. The facial expression of both heads did not have as marked an aged appearance as the photograph shows. It had one anus.

The X-Ray report to Dr. Wilson was as follows:

The two heads are well formed. The spinal columns show the usual development but the bodies of the vertebra are rotated to the median line. The second to twelfth ribs inclusive to the mesial side of both spines have fused together, bridging the space between the two columns. The two first ribs between the columns are immatured.

The right and left shoulders show their respective clavicles. A third clavicle arises on the proper level and extends directly upward in the median line between the two necks. The fragment of the fourth clavicle lies close to this one just described.

There are two hearts in this chest. There are no signs of air having entered the lungs. There is but one pelvis.

TUBE AND SCREEN

(ANONYMOUS)

With Apologies to Andrew Lang

(Note.—It has been the writer's custom to repeat to himself various verses while in the dark-room waiting for the plates to "come." The following adaptation of Andrew Lang's well known poem "Pen and Ink" is one result.)

You wanderers that were my sires,
That read men's fortunes in the hand,
That journeyed with your smithy fires
From waste to waste across the land,
Why did you leave for garb and town,
Your life by woods and meadows green;
Why lay your gypsy freedom down
And doom your child to tube and screen?

You wearied of the wild-wood meal
That crowned or failed to crown the day;
Too lazy or too tame to steal,
You broke into the beaten way,—
Plied awl and loom like other men
And learned to love the guinea's sheen.
Ah! recreant sires that doomed me then
To earn so few with tube and screen.

Where it has fallen the tree must lie,—
'Tis over late for me to roam;
But the caged bird that hears the cry
Of his wild fellows fleeting home,
Can feel no greater pang than mine
When I with ear alert and keen
Hear trout in stream and wind in pine
Call me to quit dull tube and screen.

And then the spirit slumbering
That sleeps within the blood awakes;
And then the summer and the spring
I fain would meet by streams and lakes.
But ah, my birthright long is sold,
But age and customs intervene,
And I must get me as of old,
Back to my tools, to tube and screen.

POST HOC OR PROPTER HOC?

By GEORGE M. NILES, M. D., Atlanta, Ga.

The two following cases, reported for obvious reasons, present a disquieting possibility that should be speedily recognized or disproved.

Mrs. W., aged 34, was referred to me for indefinite digestive disturbances, extending through the past five years. She reported occasional attacks of apparently causeless diarrhea, much nervousness, but no dermatitis.

Physical examination disclosed nothing except a hypersensitive abdominal surface; and a test-meal showed a stomach practically normal as to secretion and motility.

A Roentgen examination being desired by her, I made five Roentgenograms of the stomach and intestines on October 2nd, 3rd and 4th, the last being a colon injection. As she was quite stout, a 5½ inch spark-gap was used, with 80 milliamperes, each exposure being ½ a second.

On October 8th she had a lacerated perineum repaired, and the surgeon at the time of operation noted a rather augmented redness of the vagina and muco-cutaneous margin of the anus.

By October 12th she developed an acute inflammation of the mouth, tongue, rectum and vagina, coincident with extreme nausea and diarrhea, betokening an acute gastroenteritis.

A diagnosis of acute pellagra was at once made, and since that time she has followed the usual course of a severe case of pellagra with accentuated gastrointestinal and nervous symptoms. Her recovery is doubtful.

Miss A., aged 42, had been in declining health for about a year, having lost 50 pounds during the last four months. She was nervous, psychasthenic and pessimistic, with nearly constant manifestations of gastric distress.

She was referred to me only for a Roentgen examination of her digestive tract. This examination was made on October 23rd, 24th and 25th, consisting of five exposures of ½ second each, with the same spark-gap and milliamperage as the previous patient.

Considerable intestinal stasis, with a somewhat dilated cecum and colon were demonstrated, and I saw her no more.

Continuing more and more nervous, about 20 days after the Roentgen examination she developed an acute stomatitis, gastroenteritis, proctitis and vaginitis, with all the other concomitant symptoms of acute pellagra. At present she is in a precarious state.

Those who have observed pellagra well know the malign influence of strong light, especially the actinic rays of the sun, upon the skin of pellagrins. Many cases of seeming convalescence, where the dermatitis had subsided, and the other symptoms were practically quiescent, have, in my experience, been rekindled by exposure to strong light or heat, even for a brief period. In these instances an acute dermatitis over the exposed area was the first manifestation, but this was from exposure to rays which did not penetrate the skin.

In the employment of Roentgen rays, which *do* penetrate, can a latent pellagrous process in the mucous linings of the bodily orifices and the gastrointestinal tract be activated into a furious and deadly syndrome of symptoms?

"We pause for a reply."

922 Candler Building.

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EDITORIAL

If the surgeons who use steel splints would refuse to buy them of the manufacturers it would speedily compel the manufacturers to place the proper aluminum splints upon the market. It is very hard to break down the trade traditions of an established factory. If the Roentgenologists and surgeons would unite in demanding a proper translucent splint, so that cases could be accurately rayed after dressings are applied, no doubt that their demand would be soon met. It is possible to secure aluminum drinking cups, aluminum frying pans and aluminum tea kettles, but it seems to be impossible in this country to buy proper aluminum appliances for fractures.

We were recently informed that steps are about completed for the amalgamation of one of the great surgical centers of the country with an adjacent university for the establishment of post-graduate medical and surgical instruction. We hear that it is contemplated that after a prolonged course in the department of Roentgenology in the important medical center the degree of Roentgenology would be awarded. If the plans can be consummated for this system, it will be a great advance in Roentgenology; first of all to dignify the profession and to provide at least one place where trained Roentgenologists can be secured. While many critics decry the lack of training of many of those who are engaged in the practice of Roentgenology yet, if we pause to consider, we see that the opportunities for the acquirement of knowledge are comparatively limited. With the exception of magazine articles and some few text books, the majority of which are out of date, he has access to hardly any literature. If he attends some of the post-graduate courses given in some of the large cities, he is apt to be allowed to hurry through a large amount of work in a short time, and thus receive a training in superficiality rather than in thoroughness. Any institution which will require an extended course and which will furnish ample material for constant daily observation, will help the progress of Roentgenology in this country amazingly.

After our remarks last month upon the amount of space lost upon plates, when using oblong plates for exposures made with circular diaphragms, we made a few calculations as to the average monetary loss. In a laboratory whose plate bill will run perhaps about $2000.00 a year, we figured that on a very conservative estimate the money loss was about $300.00. This certainly is a large percentage to pay to the tradition of the old-time landscape photographic plate.

One of the signs of the increased interest in Roentgenology, is the fact that there are

in preparation several books which promise to be of great help to the student. One is a book on technique, published with various chapters by well-known Roentgenologists and compiled by one whose technique is of the highest order. Another work which will probably appear before many weeks takes up the study of the gastro-intestinal tract, with sufficient illustrations of proven cases to make the deductions of the greatest value. Another work on Roentgen anatomy and pathology is promised in the near future.

One of the pleasant duties of the editorial staff is to try and reconcile the writers of articles as to when their articles shall appear. Formerly when the publications of the society came out as a quarterly the editorial staff often had difficulty in getting the material for the numbers which appeared during the year. We are pleased to state that now the task is one of selection rather than solicitation.

We would apologize for the error in transposition of the legends of the cuts illustrating Dr. Stewart's article on Advanced Roentgen Technique in the Diagnosis of Oesophageal Lesions, which appeared in the October issue. The legend on page 465, Case No. 1, should be transposed with the legend on page 466, Case No. 2.

January 12, 1915

Dr. P. M. Hickey,
32 Adams Ave.,
Detroit, Mich.

Dear Doctor:—

I feel that an injustice has been done Dr. Bowen, relative to priority, in connection with his new technique for the determination of sphenoidal sinusitis.

Regardless of the source of error, I hereby ask you to publish this in toto, in a future edition, thereby giving credit where it is due.

In my discussion of Dr. Bowen's paper, I mentioned the fact, that we used Dr. Pfahler's method extensively with great satisfaction, and on account of assymmetry welcome Dr. Bowen's new method as an adjuvant examination to overcome this source of error.

Thanking you in advance, I remain

Very truly yours,

M. J. HUBENY,

Chicago, Ill.

January 23, 1915

Dr. P. M. Hickey,
Editor American Journal of Roentgenology
Detroit, Mich.

Dear Doctor:—

As chairman of the Committee to arrange for a combined midwinter Roentgen meeting and a meeting of the Chicago Medical Society to be devoted to X-ray subjects, I have been asked to write a short account of what we expect to do.

The meeting is to be held Wednesday, March 3rd. In the forenoon there are to be a number of papers on X-ray subjects, the titles and authors to be announced later. The afternoon is to be given over to the showing of slides as formerly and general discussion on these. Following this it is proposed to have an informal dinner to promote the social spirit amongst the members. The evening meeting is to take the place of the regular weekly Chicago Medical Society meeting and is to be devoted to the subject of Roentgen Therapy. Dr. Pusey will speak on the Roentgen Therapy of skin lesions, Dr. Case on the Deep Therapy of non-malignant lesions and Dr. Pfahler on the Deep Therapy of malignant lesions. On the following day an attempt will be made to hold X-ray clinics at various hospitals for those who can stay over.

Very truly yours,

ADOLPH HARTUNG,

Chicago, Ill.

ABSTRACTS

Case, James T., M. D., Battle Creek, Mich.: The Roentgenology of chronic joint disease. (Illinois Medical Journal, September, 1914.)

The various facts which may be learned from the Roentgen examination may be listed as follows:

1. Variations in the Density of Bone, evidenced by rarefaction or condensation of bone, due, respectively, to absorption of mineral matter or to an extra-deposition of mineral matter or actual growth of new bone. There are normal variations in the opacity of the bones to the Roentgen ray. From birth until early adult life there is a general increase in the density of the bones. In old age and in thinner people, the shadows of the bones generally appear to be still denser; this is not due to an actual increase in the density of the bone, however, but to a decrease in the density of the surrounding tissues.

2. Alteration of Contour. This alteration may be due to the production of osteophytes and exostoses, to subperiosteal swellings, to distortion of the bone accompanying softening and pressure, or to actual erosion of subchondral bone in the joint surface.

3. Periarticular Swelling. In order to show periarticular enlargements, it is necessary to observe certain principles of technic in the making of the roentgenogram. In other words, the quality of the ray used should be so adjusted that not only will bone detail be clearly shown, but also the surrounding soft tissues. For this purpose, a high tube is required. When tubes are too soft ("low"), the image of the bones is very black. Detail in the bone is conspicuous by its absence.

4. Anatomical Deviations, as Luxations or Subluxations. An accurate knowledge of the anatomy of the joints is, of course, essential. Another essential is the adoption of a constant technic.

5. Narrowing of Joint Slits, indicating atrophy or destruction of cartilage.

6. Bony Ankylosis may be discovered and an estimate made of the presence or absence of fibrous ankylosis. In the latter the interarticular space is represented by a clear line, while in bony ankylosis the interarticular space has disappeared and is replaced by a dark zone of about the same density as the neighboring bones with almost complete disappearance of the line of separation between the joint surfaces.

7. Calcareous or Uratic Deposits. Calcareous bodies may be evidence of lime deposits in joints or in ligaments, or the deposit may be in the bursae connected with the joint. The injection of oxygen into the joint may assist materially in the proper differentiation of calcareous masses in the neighborhood of the joints.

8. Discharging Sinuses, particularly in connection with tuberculous joints, may be helpfully studied after the injection of Beck's paste. The roentgenologist can only base his report upon the Roentgen ray findings. These findings should then be collated with other clinical evidences in the case.

Senile Arthritis. In the later years of life there are to be observed in roentgenograms of joints certain changes resembling the joint changes of arthritis deformans, which must be conceived as merely a symptom of old age.

Arthritis Deformans. In primary arthritis deformans the following findings have been described:

1. Roundish, ball-like exostoses in and around the joints, which, in joints with wide synovial pockets, may develop into loose bodies.

2. Sharp demarcation of the bones of the joints with the formation of osteophytes.

3. Lateral deposits on the borders of the capsule and outside of the joint.

Spondylitis deformans is a particularly interesting variety of arthritis deformans. The changes here correspond to those described in the hypertrophic type of chronic arthritis. The bodies of the vertebrae are asymmetrical, the hypertrophic changes occurring in the corners of the bodies and less frequently in the transverse processes. Bridge formation and adhesions, deformity of the vertebral bodies, and, finally, complete ankylosis are characteristic findings in advanced spondylitis.

Arthritis Urica. This condition is characterized by the deposit of urates in the tissue of the joint, primarily in the ligaments, but later in the articular cartilages.

Bruce has called attention to characteristic uratic deposits (Bruce's nodes) which occur as very small osteomata, on the lateral border of the proximal phalanges of the hands. Often small, and sharply marked, they are seen as additions to the outline of the bone. Since they are less opaque than the bone, the contour of the bone can be made out through them. They are best seen in the phalanges where the lateral ligaments are attached to the bone.

We should mention also the value of the Roentgen ray in noting the progress in some cases of rheumatoid arthritis of the hands. There is noted a diminution in the ulnar deviation and an improvement in the position of the small bones, corresponding to improvement in the general condition.

The writer studied by means of the Roentgen ray, certain animals in whom arthritis had been produced experimentally, as the result of certain diets. Guinea pigs were given special, exclusive diets, some a diet of milk, raw or boiled, some a diet of barley, some a diet of oats, and some a normal diet, for purposes of control. The guinea pigs on a pure milk diet developed an arthritis at a definite period, nearly always the twenty-first day. The animals on an oats diet developed an arthritis at an earlier date, about the eleventh day. There were three classes of joints examined in these guinea pig experiments:

1. Those in which there was an acute arthritis which had existed for three or four days.
2. Cases in which the joint lesion was four or five weeks old.
3. Cases in which six or eight months had elapsed since the joints were involved.

In the acute cases there was no perceptible roentgenographic change except the periarticular soft tissue swelling; in certain instances, the roughening of the epiphyses.

In the second class, where the joint lesion had existed for four or five weeks there were more marked changes perceptible, particularly rarefaction; osteophyte formation and roughening in the region of the epiphyses were still more marked.

In the healed cases there was perceptible osteophyte formation with thickened periosteum and broadening of the shaft of the bones in the epiphyseal region.

Joint Tuberculosis. In the very earliest stages of joint tuberculosis, when the disease is confined to the synovial membranes, there may be no recognizable deviation from the normal. Among the earliest changes recognizable on the roentgenogram may be included (a) absorption of lime salts, with resulting increased transparency to the rays; (b) increase of fluid in the synovial sacs. Roentgenograms of tuberculous joints are, as a rule, from the photographic standpoint, disappointing. The outlines are blurred and the spaces of the cancellous bone give an effect of fuzziness. This blurring of contour and detail of bone structure is due partly to fluid, partly to thickened synovial membranes and partly to decalcification. Bloody effusion into a joint may simulate the blurring of tuberculous disease. At the beginning, it is often difficult to recognize isolated or infiltrated tuberculous foci. The quality of the shadows must be interpreted. Errors are frequent, but the chance of error may be lessened if several roentgenograms are made in every suspected case of early joint tuberculosis, and if one compares the suspected with the sound side, until great experience in the reading of roentgenograms has been acquired.

In doubtful cases we must be suspicious of a roentgenogram which shows increased transparency with decreased accuracy of outline and bone detail. This is especially true in tuberculous disease of the carpals and the tarsals.

In later stages of tuberculous joint disease we may observe ulceration of the joint surface with irregularity of the surface of the articulation and enlargement of the articular space.

Still more advanced cases show blotches of more or less darker shade, indicating an area of tuberculous necrosis. There may be ulceration, sequestra, osteitis, osteophytes and abscess formation.

Particularly in tuberculosis of the dorsal spine, and occasionally also in tuberculosis of the lumbar spine, there may be seen a peri-spinal tumor, indicating the site of the abscess. The peri-spinal tumor is especially well seen when it occurs at a level higher than the diaphragm.

Healed tuberculosis in joints is evidenced by a thickening in the cortex of the bone, probably compensatory for the loss of strength in the cancellous tissue. This appearance is not peculiar to tuberculous lesions, however, but may attend any condition characterized by atrophy of the bone.

The Roentgen ray aids in arriving at some conclusion as to the activity of the focus. In active joint tuberculosis, even in a carefully made roentgenogram, there is blurring of the outline.

Luetic Joint Disease. The Roentgen ray findings in early syphilitic involvement of the joints are not characteristic. Unless there develops a synovial effusion, or unless one discovers the evidences of a characteristic osteoperiosteitis, the evidences are not likely to be different from those of acute articular rheumatism. As diagnostic characteristics of syphilis Redard cites the clear blotches at the level of the epiphyses, indicating the presence of an interosseous gumma and the evidence of a rarefying osteitis; the increase in the circumference of the bones seen especially in the epiphyseal region; the osteophytes; the irregularity of certain portions of the bones and spontaneous fractures. The roentgenogram does not record the exact size of gummatous deposits which are not ossified, since newformed bone is still permeable to the Roentgen ray. The ossifying process involving the capsule gives rise to a varying quantity of osseous debris within the joint, well shown in roentgenograms of typical cases.

From the Roentgen ray standpoint, the typical findings in tabetic arthropathy are the extensive proliferating and destructive processes which run a parallel course and lead to extracapsular ossifications due to bone formation in the fibrous layer of the joint capsule. Fluid in the joints, subluxations and pathological fractures, and often the absence of pain even on motion, are other diagnostic features of importance. The bone lesions sometimes resemble sarcoma.

In the tabetic form of syringomyelia, arthropathy occurs in about ten per cent. of cases. Thickening of the bones in the region of the epiphyses, osseous layers which are poor in calcium salts, and an atrophic condition of the bones, and occasional joint symptoms sometimes appear on account of interference with the trophic impulses. During healing, after fractures in this condition, there are sometimes observed excessively hypertrophic callous proliferations and ossifications in tendons.

Gonorrheal Arthritis. Gonorrheal arthritis is attended by the same bone changes as are seen in other forms of infectious arthritis. There is the same translucency of all the bones of the joint and those in the neighborhood of the joints.

Traumatic Arthritis. As the result of trauma, we find changes which may be described as atrophic arthritis or hypertrophic arthritis, or mixed atrophic and hypertrophic arthritis. The characteristic of this form of arthritis is that it occurs only in the injured joints and in the joints distal to it.

Streptococcus Arthritis. The writer studied roentgenographically the joint changes occurring in rabbits into whose ear veins there was introduced a culture from

the tonsils of patients suffering from rheumatoid arthritis. There occurred the progressive joint swelling, with later a mixture of atrophic and hypertrophic changes, until finally the picture of rheumatoid arthritis in the human was duplicated in the animal. There was also noticeable a periostitis involving the contiguous portions of the shafts of the long bones near the affected joints.

Case, J. T.: Roentgenologic observations on colonic peristalsis and antiperistalsis, with special reference to the ileocolic valve. (Med. Rec., 1914, lxxxv, 415.)

Case has examined 1,500 individuals by means of the Roentgen ray following a bismuth meal. He has recorded the findings in over sixty cases in which visible peristaltic waves have actually been seen during the fluoroscopic screen examination. In 37 cases antiperistalsis was observed. The antiperistaltic waves, in most cases, originate in the transverse colon near the hepatic flexure, proceeding toward the cecum, usually disappearing at a point corresponding approximately with the ileocolic junction. Antiperistalsis has also been seen, however, in the descending colon, especially in cases of chronic or acute bowel obstruction.

Case's observations convince him of the existence of a tonic contraction ring in the right half of the transverse colon. The exact location of this tonic ring varies with the tonicity of the proximal colon, but usually exists at a point near the middle of the right half of the transverse colon.

Case again calls attention to a phenomenon previously described by him as a sign of serious bowel obstruction, namely, exaggerated antiperistalsis. In every case of carcinoma of the colon studied, the presence of exaggerated antiperistalsis has been evident. It has occurred in all parts of the colon. It has also been recognized in spastic constipation and in benign obstructions of the bowel. In every case following ileosigmoidostomy retrograde peristalsis was observed in the left half of the colon.

Mass peristaltic waves, first described by Holzknecht, Case has seen in 37 different individuals. The bowel contents suddenly lose their haustral markings and are formed into an ovoid, sausage-shaped mass with perfectly smooth edges, rounded at the ends. This mass travels at about twice the rate of peristaltic waves in the stomach, the distance traveled varying from three to four inches to several feet. After coming to rest, the mass regains its haustral markings, the time required for the reappearance depending upon the consistency of the bowel contents—quickly, if the content be semi-fluid; more slowly, if the bowel content is of firmer consistency.

Massage and mechanical vibration were carefully studied in a number of cases. The immediate effects observed have been a deepening of the haustral contractions and sometimes the appearance of antiperistaltic waves. The conclusion was reached that the well-recognized favorable influence of massage and mechanical vibration on bowel motility must be produced indirectly through increasing the tone of the bowel muscle rather than through any actual mechanical pressure of the bowel contents onward. To produce any true electrical stimulation, a bipolar electrode must be employed.

Case gives special attention to the study of the function of the ileocolic valve, believing that our present knowledge of the antiperistaltic function of the colon demands all the more a recognition of the normal competency of the ileocolic valve. In the 1,500 cases referred to, incompetency of the ileocolic valve was found in nearly 250 instances, or one in six. Such a large proportion of incompetent ileocolic valve cases is explained by the fact that the 1,500 cases were gastro-intestinal cases submitted for bismuth meal study and hence the presence of ileocolic valve incompetency might be expected in a relatively large proportion of cases.

Case emphasizes the fact that the old idea that insufficiency of the ileocolic valve produced diarrhea is erroneous, and that, on the

contrary, in most cases the opposite condition is present, namely, constipation. Present knowledge of the antiperistaltic phenomena in the colon makes it easy to understand why ileal stasis and constipation are found rather than hypermotility when reflux from the colon into the ileum is no longer prevented by a competent ileocolic valve.

While it is generally recognized that rectal alimentation is, on the whole, unsatisfactory, there are enough cases of successful rectal alimentation to warrant the continuance of the practice. Case believes that these instances of rectal alimentation are cases of ileocolic valve incompetency.

Von Eiselsberg: Experience in the treatment of malignant tumors with radium and Roentgen rays. (Zentralbl. f. d. Ges. Chir. u. i. Grenzgeb.)

In a case of incomplete operation for carcinoma of the upper jaw it had a marked effect. In a case of carcinoma of the tongue recurrence was probably hastened; in two cases the use of radium had no effect. It should be used for curative purposes only in inoperable tumors; the results are the most favorable in basal-celled carcinoma; in 9 cases there were 7 recoveries. Eiselsberg also had good results in a carcinoma of the tongue, in a round-celled sarcoma of the axilla, and in a carcinoma of the thyroid, all of which were inoperable.

A carcinoma of the rectum that had been treated with radium could not be found on autopsy, but there were metastases in other organs, as well as a perforation of the small intestine from adhesion of two loops of intestine, due to the effect of the radium. Eiselsberg saw similar by-effects of radium in three or four cases of carcinoma of the esophagus. In all the cases there was improvement, in so far as the stenosis dilated, but in three cases there were secondary contractions above that caused by the carcinoma, which were due to radium burns. When a tumor cannot be operated on surgically, on account of intimate adhesions to important organs, it cannot be treated with radium either. Severe cachexia is caused by absorption after radium irradiation. Eiselsberg has treated many tumors with Roentgen rays. Here, too, prophylactic irradiation after operation has had very good results. A primary tumor of the testicle had been operated on with metastases in the abdomen, which disappeared under the action of Roentgen rays. Large doses must be used, and care should be taken to avoid injuries of the skin. Roentgen rays should not be used as a substitute for operation. They should only be used in inoperable cases or for prophylactic treatment after operation.

Iglauer, Samuel, M. D., Cincinnati, Ohio: Value of Roentgenography in diagnosis of diseases of larynx and trachea. (Jour. Amer. Med. Assoc., Nov. 21, 1914, p. 1827.)

In the domain of physiology the Roentgen rays have demonstrated some interesting facts concerning certain functions of the larynx. Thus the long-debated question as to whether the cricothyroid muscles act as depressors of the thyroid cartilages or as elevators of the cricoid has been definitely settled in favor of the latter by Moeller and Fischer. The various positions assumed by the lips, tongue, soft palate and larynx during phonation have been accurately determined by Scheier. He also portrays the position of the bismuth mass in the fractional part of a second required for it to pass the larynx.

Ossification of the Larynx.—According to Scheier and Fraenkel, ossification usually begins during the eighteenth or nineteenth year of life, and in both sexes is first noted in the lower part of the posterior border of the thyroid cartilages. From this region it gradually ascends along the posterior border. Ossification then gradually extends forward along the inferior border of the thyroid, giving rise to an L-shaped mass of bone.

In the male, a new center arises at the inferior thyroid notch and another along the superior thyroid border, and by the gradual coalescence of all these centers the cartilage eventually may be completely surrounded by a bony frame (after the fortieth year). In

the female the same process may occasionally occur, but more characteristic for this sex is the freedom from ossification in the anterior portions of the thyroid wings. An oblique bony line dividing the thyroid into two islands is common in the male, but practically always absent in the female. In the cricoid the process begins in the seal portion and gradually extends forward into the ring portion of the cartilage. The arytenoids are next in order and the tracheal rings are among the last to show signs of ossification. Roentgenoscopy has proved that ossification may also occur in the epiglottis.

TECHNIC: Roentgenography of the larynx in the living is easily carried out. The patient sits on a chair or lies on a couch with the plate (8 by 10) in contact with the side of the neck and parallel to the median plane of the body. The patient is instructed to hold his breath and not to swallow during the exposure, which requires about six seconds. A profile picture of the larynx is thus obtained with one side of the larynx superimposed on the other, but the side in contact with the plate comes out very distinctly.

TUBERCULOSIS OF THE LARYNX.—Characteristic of this disease is a peculiar hazy, indistinct outline of the laryngeal cartilages, giving the impression of an over-exposed picture. It indicates clearly that the tuberculous process is not confined to the lining mucosa of the larynx, but that changes occur in the underlying cartilage associated with the resorption of bone. In addition to the changes in the cartilage, the infiltration of the soft parts, such as the aryfolds, stands out distinctly. Defects or infiltration of the epiglottis give characteristic pictures. Roentgenography offers another demonstration of the fact that tuberculous lesions are almost always more extensive than the image in the laryngeal mirror would indicate.

SYPHILIS.—The roentgenograms in syphilis give sharp, distinct pictures of the ossified portions of the larynx. Infiltration or defects in the soft parts may also be made out. In doubtful cases, roentgenography should be of considerable value in demonstrating syphilitic perichondritis, and in differentiating syphilis from tuberculosis.

CARCINOMA.—Carcinoma of the larynx usually occurs in the ossified larynx of the aged, and this tends to obscure intralaryngeal tumors. Nevertheless, a massive tumor can often be made out, and if the lumen be encroached on, the narrowed air-passage can be seen. Tumors of the epiglottis or aryfolds are more readily delineated.

STENOSES OF THE LARYNX.—In obstruction of the larynx or trachea by foreign bodies, or by tumors or cicatrices within the air-tract, or by compression from without, the tumor is often visible and the narrowed lumen appears distinctly. Roentgenography demonstrates very beautifully the deposits of limesalts which so frequently occur when the laryngeal or tracheal cartilages have been incised.

Krotoszyner, Martin, M. D., San Francisco, Cal.: Differential diagnosis of nephrolithiasis and renal tuberculosis by Roentgenography. (Jour. Amer. Med. Assoc., Dec. 5, 1914, p. 2006.)

As regards the roentgenographic differentiation of tuberculous calcifications from lithiasis, the partial or total so-called putty-kidney presents such definite and characteristic plate-features that on its basis alone a correct diagnosis may be feasible. The first case of a roentgenographically recognized partial putty-kidney was reported by Forsell and Josefsson, in 1908. Two years later Hurter published the first plate of a total putty-kidney, in which the diagnosis of marked tuberculous calcifications of the right kidney and ureter was afterward verified at the post-mortem examination, when the parenchyma of the right kidney was found to be replaced by large cavities filled with cheesy material. Quite recently two cases of total putty-kidney in which the operative indications were based solely on roentgenographic findings afterward proved to be correct at the operation, were reported by Söderlund.

The correct interpretation of suggestive concrement shadows is very difficult even in

the presence of more or less characteristic features pointing to tuberculosis. When these are absent, though, the resemblance of tuberculous foci to calculi shadows is so striking that a correct plate diagnosis is well-nigh impossible, as in the following observation:

A stout woman of forty-four, of excellent physique, had suffered for the last eighteen months from attacks of typical right-sided kidney colic and frequent and painful micturition. Repeated urinalyses demonstrated a moderate amount of pus and blood, and no tubercle bacilli. At the hospital the physical examinations, including kidney palpation, proved negative. Cystoscopy showed a perfectly normal bladder, except for a moderate cystitis coli, and no abnormality in appearance and spurt of either ureter. The urine of the right side was slightly cloudy and contained, microscopically, pus and blood in moderate amounts, while the secretion of the left kidney was normal in appearance and microscopically. The various functional tests showed good values on both sides; in fact, a slight but uniform superiority of function of the suspected right kidney (sugar after phloridzin 1.2 on the right against 1.0 on the left side, etc.). No tubercle bacilli in right renal secretion. Repeated roentgenographic exposures, including a pyelogram, showed on the right side two small round and well-defined shadows, which were interpreted as calculus shadows.

The exposed right kidney presented, near its lower pole, two small cavities filled with a gritty caseous material. The removed kidney showed, in the region of its pelvis, granulation and cicatricial tissue in which tubercle bacilli with giant-cells were present (chronic tuberculosis).

From our present meager knowledge of the differential diagnostic aspect of plate shadows, it appears that, in a great many instances, a correct roentgenographic differentiation between renal tuberculosis and lithiasis is not feasible. This is particularly true of one or more small and circumscribed shadows cast by scattered foci of tuberculous caseation. Such shadows look so much like stone-shadows that a correct local diagnosis, on the sole basis of plate-findings, is utterly impossible. Only the tuberculous putty-kidney presents sufficiently characteristic roentgenographic features to permit of a correct local diagnosis. Pyelography may occasionally be of definite differential diagnostic value. This method, though, is too risky a procedure in renal tuberculosis to become a routine measure in doubtful cases.

Another source of error may arise from the possibility that a shadow seen on the renal plate is cast by an object outside the kidney. While, thus, the differential diagnosis of nephrolithiasis and renal tuberculosis by roentgenography alone is in most instances difficult and often impossible, it is, nevertheless, capable of yielding better results with growing experience in the interpretation of suspicious shadows.

Pfahler, George E., M. D., Philadelphia: Electrothermic coagulation and Roentgen therapy in the treatment of malignant disease. (Surg., Gyn. and Obst., December, 1914, p. 783.)

The method consists in the complete destruction, or the removal, of all visible and palpable malignant disease by means of the d'Arsonval current, followed, or at times preceded, by full doses of the Roentgen rays, given from as many different fields of entrance as is possible, so that as much irradiation is produced as though the rays alone were depended on for the cure of the disease.

The technic of the electrothermic coagulation is somewhat similar to that described by Nagelschmidt and in principle is identical. The d'Arsonval current is used, and an instrument is necessary which will generate from one thousand to two thousand Ma. of current. The amount of current will vary with the amount of destruction of tissue necessary.

The two electrodes are used, attached to the two poles. The shape and character of the electrode will vary with the character of work required. For instance, if one desires to remove a portion of a lip, Pfahler uses,

on the inside, a ball electrode about three-eighths of an inch in diameter, and on the outside, a needle-point electrode. Then he outlines the area of the diseased tissue to be removed, by allowing the current to flow from this point toward the ball electrode on the inside, and coagulates the entire diseased tissue. At first he depended on the needle electrode actually to carve out the diseased tissue, but now finds it simpler to cut this away with a pair of curved scissors, after coagulation, always cutting within the coagulated tissue. In this way there is no bleeding, and the edges are completely sealed off. The blood vessels and lymphatics are at no time opened, which is a distinct advantage in the prevention of metastasis and ultimate cure of the patients. In destroying an extensive lesion in the cheek, Pfahler uses a flat electrode, one inch in diameter, on the inside, and a point electrode on the outside. In destroying a portion of the tongue, Pfahler has used two-point electrodes. The electrodes are held in contact with the tissue.

In this extensive destruction the pain is intense, and some form of general anesthetic is always necessary. For mouth cases Pfahler uses local anesthesia.

The object of the Roentgen therapy is to control or destroy the outlying cells or metastases that may be missed in the coagulation process. Therefore, the treatment must be thorough and given with the understanding that disease may still be present; for if one is sure of having destroyed all of the malignant disease, there is no object in adding the Roentgen therapy. This treatment must always be given with the technic used for deep disease, for one should never leave any superficial or visible disease behind.

Pfahler commonly precedes the tissue-destruction by a series of treatments or doses, given through as many areas as is possible, covering the entire periphery and glandular areas which are likely to be involved by metastasis. In two weeks, after the destruction of the disease, this series of treatments is repeated and again subsequently at intervals of three weeks or longer, as often as seems necessary from the nature and the extent of the disease. When Roentgen therapy does not precede the electrothermic coagulation, one should follow it with these treatments just as soon as the patient can be moved to the laboratory, which is usually within a day or two.

The skin dose must be carefully measured, so as to give all that the skin will tolerate without doing damage. This is the erythema dose, and when measured by the Kienboch quantimeter, it equals 10 X of unfiltered rays; measured by the Saboraud and Noire pastilles, the erythema dose is recognized by tint "B"; measured by the Holzknecht radiometer, the dose equals 10 units. When the rays are filtered through three millimeters of aluminum and one-eighth of an inch of sole leather under the aluminum, and when the rays are given from a tube producing uniform, highly penetrating rays, 7-8 Benoist, the dose can be increased to 20, measured under the filters. This alone multiplies the deep effect by three.

The skin area and the number of areas through which each dose is given will vary with the extent and depth of the disease, the amount of, or tendency to, glandular metastasis, and the degree of malignancy. The size of each area will depend on the number of points of entrance required and the extent and depth of the disease. The deep effect is multiplied by the number of points of entrance.

The quality of rays used is measured chiefly in its degree of penetrative power according to one of the scales. For example, measured by the Benoist penetrometer, it should register 7 to 8.

Cases Suitable for this Combined Form of Treatment.—(1) Those cases in which there is a considerable area of malignant tissue, which can be removed en masse and which is too great to be destroyed completely by the electrical desiccation described by Clarke. For small superficial epitheliomata, warts, moles, and birthmarks, Pfahler much prefers the desiccation method. (2) Epitheliomata involving the deeper portions of the lip, cheek, tongue, or alveolar process,

especially those which have been treated for a considerable time with the Roentgen rays, without success. Epitheliomata on other parts of the body, which are large, and especially if they must be allowed to heal by granulation. (3) Old adherent scirrhous carcinomata of the breast in which there is no evidence of metastasis, and which are considered inoperable by surgical means.

DISADVANTAGES OF THE TREATMENT.—(1) There is complete destruction of all the tissue between the two electrodes. Therefore, there is no chance of saving the blood vessels or nerves which are in close proximity to the disease. (2) It leaves an open area, which is healed by granulation, but at times this healing must be followed by a surgical plastic operation to close the mouth or to correct some deformity.

ADVANTAGES.—(1) There is complete destruction of the local malignant disease. (2) This is accomplished without opening the blood vessels or the lymphatics, and Pfahler believes that this method of treatment is less likely to be followed by a recurrence or metastasis. (3) The wound heals with a smooth, soft scar, which resembles skin very closely. (4) At times one is enabled to apply this combined treatment in surgically inoperable cases.